Dickie, Catherine

From:

MacDougall, Lesley

Sent:

January-17-19 4:52 PM

To:

Lowe, Carmel

Subject:

RE: For your awareness - planned Technical Briefing on PRV the last week of January

That I can do ©

From: Lowe, Carmel

Sent: January-17-19 4:29 PM

To: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: Re: For your awareness - planned Technical Briefing on PRV the last week of January

From reading the email chain I expect that Arran will bring Jay and Wayne - - and your presence will be required just to listen....

Carmel

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: MacDougail, Lesley

Sent: Thursday, January 17, 2019 16:27

To: Lowe, Carmel

Subject: RE: For your awareness - planned Technical Briefing on PRV the last week of January

If some of the specific questions are what are we expecting to know from the PRV peer review then Jay should likely also attend?

From: Lowe, Carmel

Sent: January-17-19 4:17 PM

To: MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca >

Subject: Fw: For your awareness - planned Technical Briefing on PRV the last week of January

If his mtg is at 10am - which I suspect it is from emails below then I will be in mtg with Brian and Rebecca. Are you available to participate?

Carmel

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: Reid, Rebecca < Rebecca. Reid@dfo-mpo.gc.ca>

Sent: Thursday, January 17, 2019 16:11

To: Fogliato, Cara Cc: Lowe, Carmel

Subject: RE: For your awareness - planned Technical Briefing on PRV the last week of January

Yes, we need a science rep – someone who can speak to the PRV issue. Carmel, preferably, or Lesley McDougal perhaps. Carmel should weigh in.

RR

Rebecca Reid

Regional Director General/ Directrice générale régionale

Fisheries and Oceans Canada - Pacific Region/ Pêches et Océans Canada - Région du Pacifique

200-401 Burrard Street / 401, rue Burrard, bureau 200

Vancouver, BC/CB V6C 3S4 Office / Téléphone: 604-666-6098

Cell / Cellulaire:

E-mail/ Courriel: rebecca.reid@dfo-mpo.gc.ca

From: Fogliato, Cara < Cara. Fogliato@dfo-mpo.gc.ca>

Sent: Thursday, January 17, 2019 3:54 PM

To: Reid, Rebecca < Rebecca. Reid@dfo-mpo.gc.ca>

Subject: RE: For your awareness - planned Technical Briefing on PRV the last week of January

Rebecca, Karen sent your regrets for this meeting. Would you like someone else to attend? There are two PAC agenda items.

Erin Campbell for Cara Fogliato

A/Executive Assistant to the Regional Director General/ Assistant Exécutif au Directrice Général Régional

Tel: 604-666-1376/Fax: 604-666-8956

From: Hill, Johanna

Sent: January-17-19 3:01 PM

To: McPherson, Arran; Reid, Rebecca; Kaba, Kyle; Northcott, Jennifer; McGill, Stephanie; Hubley, Marian **Cc:** Quinn, Caroline; Kahn, Zoe; Jarjour, Jasmine; Robinson, Connor; Hirani, Samia; Moore, Wayne **Subject:** RE: For your awareness - planned Technical Briefing on PRV the last week of January

On it. I'd suggest adding it to the Friday fallout agenda, which I was just about to re-schedule for 1pm (Ottawa time). Hopefully this works for everyone. Invitation to follow shortly.

Alain

De: McPherson, Arran

Envoyé: 17 janvier 2019 17:38

À: Hill, Johanna <<u>Johanna.Hill@dfo-mpo.gc.ca</u>>; Reid, Rebecca <<u>Rebecca.Reid@dfo-mpo.gc.ca</u>>; Kaba, Kyle <<u>Kyle.Kaba@dfo-mpo.gc.ca</u>>; Northcott, Jennifer <<u>Jennifer.Northcott@dfo-mpo.gc.ca</u>>; McGill, Stephanie <<u>Stephanie.McGill@dfo-mpo.gc.ca</u>>; Hubley, Marian <<u>Marian.Hubley@dfo-</u>

mpo.gc.ca>

Cc: Quinn, Caroline < Caroline.Quinn@dfo-mpo.gc.ca>; Kahn, Zoe < Zoe.Kahn@dfo-mpo.gc.ca>; Jarjour, Jasmine < Jasmine.Jarjour@dfo-mpo.gc.ca>; Robinson, Connor < Connor.Robinson@dfo-mpo.gc.ca>; Hirani, Samia < Samia.Hirani@dfo-mpo.gc.ca>; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca>

Objet: RE: For your awareness - planned Technical Briefing on PRV the last week of January

Hi all, spoke with Kevin.

Johanna, could we set something up with MINO for tomorrow? Kevin would like to be invited as well. Thanks, Arran.

s.16(2)(c)

Document Released Under the Access to Information Act / Document divulgué en vertu de la Loi sur l'accès à l'information.

From: Hill, Johanna

Sent: Thursday, January 17, 2019 2:38 PM

To: Reid, Rebecca <<u>Rebecca.Reid@dfo-mpo.gc.ca</u>>; McPherson, Arran <<u>Arran.McPherson@dfo-mpo.gc.ca</u>>; Kaba, Kyle <<u>Kyle.Kaba@dfo-mpo.gc.ca</u>>; Northcott, Jennifer <<u>Jennifer.Northcott@dfo-</u>

mpo.gc.ca>; McGill, Stephanie < Stephanie.McGill@dfo-mpo.gc.ca>; Hubley, Marian

<Marian.Hubley@dfo-mpo.gc.ca>

Cc: Quinn, Caroline < Caroline.Quinn@dfo-mpo.gc.ca>; Kahn, Zoe < Zoe.Kahn@dfo-mpo.gc.ca>; Jarjour, Jasmine < Jasmine.Jarjour@dfo-mpo.gc.ca>; Robinson, Connor < Connor.Robinson@dfo-mpo.gc.ca>; Hirani, Samia < Samia.Hirani@dfo-mpo.gc.ca>

Subject: Re: For your awareness - planned Technical Briefing on PRV the last week of January

Thanks, Rebecca. Looping in Science and Comms, as I understand requests came in to them from MINO through various channels.

Just want to make sure we're all on the same page.

Arran, as discussed with Jennifer, I will wait for your/DMO's signal on next steps to brief MINO.

Thanks.

Alain

For Johanna

From: Reid, Rebecca

Sent: Thursday, January 17, 2019 12:56 PM

To: Simons, Fiona

Cc: Tran, Thi; Kaba, Kyle; Hill, Johanna

Subject: Re: For your awareness - planned Technical Briefing on PRV the last week of January

Yes, we will follow up.

RR

Sent from my Samsung Galaxy smartphone.

----- Original message -----

From: "Simons, Fiona" < Fiona. Simons@dfo-mpo.gc.ca>

Date: 2019-01-17 9:27 AM (GMT-08:00)

To: "Reid, Rebecca" < Rebecca. Reid@dfo-mpo.gc.ca>

Cc: "Tran, Thi" <Thi.Tran@dfo-mpo.gc.ca>

Subject: FW: For your awareness - planned Technical Briefing on PRV the last week of January

Hi Rebecca.

Alexis asked that I do a bit of digging on this one. Do we have the content of these reports? What do we expect to hear out of the peer review meeting? Will there be anything new coming out of this that we should be prepared to answer to?

Any further information you might have on this would be extremely helpful for our awareness and planning purposes.

Thanks, Fiona

Fiona Simons

Pacific Desk

Office of the Minister of Fisheries, Oceans, and the Canadian Coast Guard

T:

E: Fiona.Simons@dfo-mpo.gc.ca

From: ComApproval / Approbation (DFO/MPO) **Sent:** Wednesday, January 16, 2019 9:40 AM

To: Mitchell, Laura; Lubczuk, Jocelyn; Tran, Thi; Simons, Fiona

Cc: Hubley, Marian: Jenkins, Phil; Ouinn, Caroline; Choeurng, Stephanie; Windsor, Victoria; ComApproval / Approbation

(DFO/MPO); McIntyre, Alexis; Hill, Johanna

Subject: For your awareness - planned Technical Briefing on PRV the last week of January

Hi Laura, Jocelyn, Thi and Fiona,

For your awareness, the Canadian Science Advisory Secretariat will be holding a peer-review meeting in Vancouver from January 28-30, 2019, to review various scientific reports and provide advice on the risk to Fraser River sockeye salmon due to Piscine Orthoreovirus (PRV) transfer from Atlantic salmon farms located in the Discovery Islands area, British Columbia. A full report will be published on the CSAS website in late spring 2019.

The department will lead a media technical briefing on the preliminary findings of the peer review meeting. The briefing will be held shortly after the meeting (timing TBD) and will include the participation of the two non-DFO co-chairs of the review.

We have drafted a communications plan which is currently on its way to you through approvals. Feel free to contact us with any questions in the meantime.

Tina

Christina (Tina) Morris
Manager/Gestionnaire
Ministerial Events and Editorial Services
Department of Fisheries and Oceans/ Pêches et Océans Canada (613) 993-5983
(_______(cell)
PIN:

christina.morris@dfo-mpo.gc.ca

s.16(2)(c)

Dickie, Catherine

From:

Fogliato, Cara

Sent:

January-18-19 6:36 AM

To:

Lowe, Carmel

Subject:

Re: For your awareness - planned Technical Briefing on PRV the last week of January

Thank you Carmel. Will Lesley attend in person or by phone?

Erin Campbell for Cara Fogliato

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: Lowe, Carmel

Sent: Thursday, January 17, 2019 4:26 PM

To: Reid, Rebecca; Fogliato, Cara

Cc: MacDougall, Lesley

Subject: Re: For your awareness - planned Technical Briefing on PRV the last week of January

Hi Cara

If the briefing is at 10am which it seems to be from email below. Then I will have some conflict as Rebecca. Lesley is available to participate.

Carmel

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From: Reid. Rebecca

Sent: Thursday, January 17, 2019 16:11

To: Fogliato, Cara **Cc:** Lowe, Carmel

Subject: RE: For your awareness - planned Technical Briefing on PRV the last week of January

Yes, we need a science rep – someone who can speak to the PRV issue. Carmel, preferably, or Lesley McDougal perhaps. Carmel should weigh in.

RR

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Regional Director General/ Directrice générale régionale

Fisheries and Oceans Canada - Pacific Region/ Pêches et Océans Canada - Région du Pacifique

200-401 Burrard Street / 401, rue Burrard, bureau 200

Vancouver, BC/CB V6C 3S4 Office / Téléphone: 604-666-6098

Cell / Cellulaire:

E-mail/ Courriel: rebecca.reid@dfo-mpo.gc.ca

s.16(2)(c)

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Cc: "Tran, Thi" < Thi. Tran@dfo-mpo.gc.ca>

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Fiona Simons

Pacific Desk s.16(2)(c)

Office of the Minister of Fisheries, Oceans, and the Canadian Coast Guard

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(DFO/MPO); McIntyre, Alexis; Hill, Johanna

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Department of Fisheries and Oceans/ Pêches et Océans Canada (613) 993-5983

PIN: (cell)

christina.morris@dfo-mpo.gc.ca

s.16(2)(c)

Dickie, Catherine

From: MacDougall, Lesley
Sent: January-22-19 8:33 AM

To: Lowe, Carmel

Subject: FW: DFO PRV CSAS peer-review meeting - documents

Attachments: Working Paper 1 - PRV Characterization.pdf; Working paper 2 - PRV risk assessment.pdf;

PRV CSAS Agenda_January 28-30, 2019.pdf

Hi Carmel – here are the working papers, and agenda, for the national PRV CSAS meeting coming up at the end of the month which, coincidentally, you could now attend!

From: Jones, Simon <Simon.Jones@dfo-mpo.gc.ca>

Sent: January-21-19 1:58 PM

To: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca> Subject: FW: DFO PRV CSAS peer-review meeting - documents

From: Malcolm, Gabrielle < Gabrielle. Malcolm@dfo-mpo.gc.ca >

Sent: Tuesday, January 15, 2019 2:20 PM

To: Mimeault, Caroline < Caroline.Mimeault@dfo-mpo.gc.ca>; Boily, France < France.Boily@dfo-mpo.gc.ca>; Garver, Kyle < Kyle.Garver@dfo-mpo.gc.ca>; Polinski, Mark < Mark.Polinski@dfo-

mpo.gc.ca>; Johnson, Stewart < Stewart.Johnson@dfo-mpo.gc.ca>; Jones, Simon < Simon.Jones@dfo-

mpo.gc.ca>; Holt, Kendra < Kendra. Holt@dfo-mpo.gc.ca>

Cc: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Burgetz, Ingrid <Ingrid.Burgetz@dfo-mpo.gc.ca>

Subject: DFO PRV CSAS peer-review meeting - documents

Hello everyone,

Please find attached the working papers and the CSAS agenda for the upcoming peer-review meeting January 28-30 at the Delta Vancouver Suites.

Thank you all for your continued hard work and dedication, which has made this all possible.

If you have any questions or concerns, please do not hesitate to contact me.

Kindest regards,

Gabrielle Malcolm

Science Advisor, Aquaculture Regulatory Sciences, Aquaculture, Biotechnology and Aquatic Animal Health Science Branch

Fisheries and Oceans Canada / Government of Canada gabrielle.malcolm@dfo-mpo.gc.ca / T: 613-949-7466

Conseillère des sciences, sciences de réglementation de l'aquaculture, Direction des sciences de l'aquaculture, de la biotechnologie et santé des animaux aquatiques Pêches et Océans Canada / Gouvernement du Canada qabrielle.malcolm@dfo-mpo.gc.ca / T: 613-949-7466

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Ecosystems and Oceans Science

Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2019/nnn National Capital Region and Pacific Region

DRAFT (January 15, 2019) Do not cite or distribute

Characterization of piscine orthoreovirus (PRV) and associated diseases to inform pathogen transfer risk assessments in British Columbia

Mark Polinski and Kyle Garver

Fisheries and Oceans Canada **Pacific Biological Station** 3190 Hammond Bay Road Nanaimo, British Columbia, V9T 6N7



Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the Secretariat.

Published by:

Fisheries and Oceans Canada Canadian Science Advisory Secretariat 200 Kent Street Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/csas-sccs@dfo-mpo.gc.ca



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Aussi disponible en français: (only if the Research Document is to be translated)

Auteurs, I. Année de publication (c.-à-d. 2019) Titre – doit correspondre exactement à la page couverture. Secr. can. de consult. sci. du MPO. Doc. de rech. 2019/nnn. vi + xx p., - Style: "citation – translated".

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ABSTRACT

Piscine orthoreovirus (PRV) is a common and pervasively distributed virus of salmon. In Canada, nearly all sea-farmed salmon likely become infected with PRV prior to harvest and the virus has been detected in archived specimens dating back to at least the mid 1980's in British Columbia, Wild salmon (all species) also occasionally become infected with PRV. Prevalence is generally lower in wild populations than on farms, and not all salmon species are equally susceptible to PRV infection. Specifically, Sockeye Salmon appear mildly refractory compared to other species such as Atlantic Salmon. Among the wild Pacific salmon species in the Eastern Pacific. Coho and Chinook salmon have the highest prevalence of PRV (approximately 9% and 6%, respectively); this prevalence appears independent from whether fish were collected from locations in close proximity to salmon farming or from areas devoid of salmon farming. The cumulative prevalence of PRV detected in Sockeye Salmon of Western North America over the past decade is approximately 1.5% based on the sampling of nearly 7,000 specimens of which more than 6,000 were collected from British Columbia stocks. Nonetheless, laboratory studies demonstrate that PRV infected Atlantic Salmon (dependent upon stage of infection) can transmit virus to cohabitating Sockeye Salmon; although the minimum exposure time, dose, and whether such transmission requirements would be reached in natural environs remain unknown. In some farmed salmon, PRV has caused disease - namely, cardiopathy and/or anemia particularly in Europe and Japan. In farmed salmon of British Columbia, on rare occurrences, PRV has been detected in diseased Atlantic and Chinook salmon where the virus may have contributed to or caused the disease. This includes at least one instance of severe cardiopathy in farmed Atlantic Salmon and one instance of anemia in farmed Chinook Salmon in the past decade. If or when disease may manifest as a result of PRV infection is not well understood. appearing to require complex etiological factors that include host, virus, and environmental components. Both regional as well as viral strain-specific variations in virulence have been documented, and disease has, as yet, only been identified in farmed salmon populations. Important to discussions of PRV in Canada is that PRV in the Eastern Pacific appears less virulent in comparison to PRV in the Eastern Atlantic, and experimental infection of Sockeye and Atlantic salmon with the PRV strain endemic to the Eastern Pacific has failed to manifest significant disease or impact respiratory function even though extreme systemic blood infections developed in both species. Furthermore, stressors such as smoltification, hypoxia, exhaustive chasing, or secondary viral (infectious hematapoeitic necrosis virus) superinfection of salmon have not induced or enhanced this PRV virulence. Thus, neither the presence nor quantity of PRV generated during an infection is indicative of disease or physiological impairment in salmon of British Columbia.

RÉSUMÉ

Le Résumé et le *Abstract* sont obligatoires. Cette section sera affichée sur le site du SCCS en format HTML suivi du lien vers la version complète de la publication en format PDF.

La longueur recommandée est de ½ page.

Prière de contacter votre coordonnateur du CAS pour la traduction du Résumé/Abstract.

Le Résumé de doit pas être plus long qu'une demi page (environ 400 mots).

1	INTRODUCTION
2 3 4 5 6 7 8	Fisheries and Oceans Canada (DFO) has a regulatory role to ensure the protection of the environment while creating the conditions for the development of an economically, socially and environmentally sustainable aquaculture sector. Restoring funding to support federal ocean science programs to protect the health of fish stocks, to monitor contaminants and pollution in the oceans, and to support responsible and sustainable aquaculture industries in Canada has been identified as a top priority of the Minister of Fisheries, Oceans and the Canadian Coast Guard.
9 10 11 12 13 14	It is recognized that there are interactions between aquaculture operations and the environment (Grant and Jones, 2010). One interaction is the risk to wild salmon populations resulting from the potential spread of infectious diseases from Atlantic Salmon (<i>Salmo salar</i>) farms in British Columbia (BC) (Cohen, 2012). While several Atlantic Salmon farms are located within the migratory routes of Pacific salmon species, no risk assessment has been conducted to specifically determine the risk to wild fish populations associated with pathogens released from Atlantic Salmon farms.
16 17 18 19	DFO Aquaculture Management Division requested formal science advice on the risks of pathogen transfer from Atlantic Salmon farms to wild fish populations in BC. Given the complexity of interactions between pathogens, hosts and the environment, DFO will deliver the science advice through a series of pathogen-specific risk assessments followed by a synthesis.
20	PURPOSE OF THIS DOCUMENT
21 22 23 24 25 26 27 28 29	The information summarized in this document will assist in the environmental assessment of the risk to Fraser River Sockeye Salmon (<i>Oncorhynchus nerka</i>) due to the occurrence of piscine orthoreovirus (PRV) infection on Atlantic Salmon farms located in the Discovery Islands area of British Columbia. This document is designed to be a focused consideration on PRV as a potential causative or contributing agent of disease in salmon of British Columbia which might be presumed to occur and putatively impact Fraser River Sockeye Salmon. As a consequence, this document concentrates on data pertinent to the transmission, pathogenicity (potential for causing disease) and virulence (potential for disease severity) of PRV to Sockeye Salmon occurring in the Discovery Islands area.

30	GENERAL CONSIDERATIONS
31 32 33 34 35 36 37	Reovirus infections of salmon are widespread and nearly all farmed stocks become infected at some time during a production cycle. The vast majority of these infections do not result in notable disease. Nevertheless, in some instances low-virulence disease syndromes of salmon have been associated with aquatic reovirus infections; specifically, field and laboratory studies with piscine orthoreovirus (PRV) have identified an etiological link between at least two PRV isolates and circulatory diseases: cardiopathy (heart disease) and/or anemia (insufficient number of red blood cell or hemoglobin) (Takano et al., 2016; Wessel et al., 2017).
38 39 40 41 42 43 44	Reovirus infections are also regionally ubiquitous in wild salmon, although prevalence in and across wild stocks are generally lower than among farms. To our knowledge, there is no direct evidence that reovirus infections (and specifically PRV infections) cause disease in populations of wild salmon. Nevertheless, indirect inference from the fact that reoviruses can sometimes cause disease in farmed salmon suggests that similar diseases may occur in wild salmon assuming all host, environmental, and pathogen specific factors can be fulfilled in a natural setting.
45 46 47 48 49 50 51	A chief consideration in assessing PRV related risks is that the potential for PRV to cause disease in farmed salmon appears to be a tenuous and complex process with regional variability and high dependence on host, virus, and environmental factors (Garver et al., 2016a; Polinski e al., <i>in press</i>). This complexity becomes further complicated by dynamic industry and natural field environments such as those found in the Discovery Islands Region of Canada. Recent scientific investigations have identified several putative factors involved in PRV-associated disease, but much is still unknown.
52 53 54 55 56 57 58	Importantly, PRV presents an atypical example of a microbial pathogen in that the quantity of virus generated during an infection appears to have little influence on whether a fish becomes diseased or how severe an associated disease becomes (Polinski et al., <i>in press;</i> Zhang et al., <i>in press</i>). This is counterpoint to most animal pathogens for which disease presence and severity is directly correlated with pathogen load. As a consequence, the risks associated with PRV on salmon health require careful and atypical considerations relative to other salmon pathogens currently of note in British Columbia.
59 60 61 62 63 64 65 66	In this document, we provide an overview of PRV and highlight its potential and variable ability to cause disease in salmon. We then review two disease states (cardiopathy and anemia) within farmed salmon of British Columbia for which there is indirect evidence that PRV might have the ability to be a contributing or causative factor. Finally, we discuss current knowledge about the tenuous interrelationship of PRV and these disease states in salmon of British Columbia and specifically how this relates to Sockeye Salmon. This review focuses considerably on one genogroup of PRV (PRV1) because it is the only genogroup that has been detected in North America and is also the most well studied.
67	PISCINE ORTHOREOVIRUS
68	GEOGRAPHIC DISTRIBUTION AND GENETIC TYPES
69 70 71 72 73	PRV is a non-enveloped, double stranded RNA virus within the <i>Reoviridae</i> family (Palacios et al., 2010; Kibenge et al., 2013) that is globally distributed (Figure 1). PRV has been generally accepted as a species within the orthoreovirus genus due to its 10 linear dsRNA segmented genome and phylogenetic ordination to other orthoreoviruses (Markussen et al., 2013). However, distinction between the orthoreovirus and aquareovirus genus is currently not well

- 74 defined and a need for taxonomic reassessment has been suggested given the common yet
- 75 divergent ordination of PRV to both genera (Nibert and Duncan, 2013), the likely common
- ancestry of the two genera (Attoui et al., 2002), and the recent discovery of additional putative
- orthoreoviruses in multiple divergent fish lineages including cartilaginous fish (Shi et al., 2018).
- 78 Of specific relevance to PRV is that this virus is phylogenetically distinct from other currently
- 79 known species in both the aquareovirus and orthoreoviruse genera with unique genotypic and
- 80 phenotypic characteristics (Key et al., 2013; Roscow et al., 2018).
- Within the current PRV genus, more than 20 isolates have yielded fully sequenced genomes.
- 82 Phylogenetic analyses using amino acid and nucleotide sequences from multiple genomic
- 83 segments suggest three distinct genogroups: PRV1, PRV2 and PRV3 (Dhamotharan et al.,
- 84 2018; Kuehn et al., 2018). Each genogroup appears to be loosely segregated by geographical
- 85 and/or host species divisions, although exceptions exist, and to date isolates from multiple PRV
- 86 genogroups have not been detected within a single individual host. Nevertheless, members of
- 87 all three genogroups appear to specifically target salmon, have a proclivity for infecting red
- 88 blood cells that lead to extensive systemic blood infections, and are suggested to be within a
- 89 single genus based on current orthoreovirus taxonomic characterization (King et al., 2011;
- 90 Markussen et al., 2013).

PRV1

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- 92 PRV1 was first identified in Norway (Palacios et al., 2010) and has since been ubiquitously
- 93 detected in that country (Lovoll et al., 2012; Wiik-Nielsen et al., 2016). PRV1 is also commonly
- 94 detected in farmed Atlantic Salmon from Canada, Chile, the United Kingdom, Ireland, Iceland,
- 95 Germany and the United States (Table 1) (Biering and Garseth, 2012; Garseth et al., 2013;
- 96 Kibenge et al., 2013; Marty et al., 2015; Siah et al., 2015; Garver et al., 2016b; Adamek et al.,
- 97 2018). Retrospective studies of archival specimens have identified a historical presence of
- 98 PRV1 in Atlantic Salmon in both Norway and Canada dating back to at least the mid 1980's,
- 99 with presumed high prevalence in farmed populations during much of that time (Marty et al.,
- 100 2015; Markussen et al., 2018). Phylogenetic comparisons of the PRV1 S1 genomic segment –
- 101 which codes the outer clamp protein σ3 of the viral capsid and displays high sequence
- 102 heterogeneity between isolates further suggests possible additional delineations within this
- 103 genogroup. Specifically, PRV1a and PRV1b subgroups has been proposed (Kibenge et al.,
- 104 2013). However, as more PRV1 sequences become available, new preliminary evidence
- 105 suggests that whole genome sequence comparisons may provide a clearer picture of PRV1's
- divergent regional evolution than S1 alone (Siah et al., 2018), and may prove particularly
- 107 significant as additional preliminary evidence suggests that segment reassortment may be
- 108 occurring in Norway between subgroups; i.e., between PRV1a and PRV1b (Markussen et al.,
- 109 2018). Of importance with regard to PRV in British Columbia is that there appears to be
- 110 relatively high genome homology between PRV1 isolates within the Eastern Pacific and that
- 111 these isolates are notably distinct from isolates sequenced from PRV1 in the Atlantic (Siah et
- 112 al., 2015; Di Cicco et al., 2018; Siah et al., 2018; Polinski et al., *in press*).

PRV2

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- 114 The second PRV genotypic variant (PRV2) is currently only associated with Coho Salmon
- 115 (Oncorhynchus kisutch) in Japan (Takano et al., 2016), and to date has not been detected in
- any other country or fish species. Although the historic prevalence of PRV2 is unknown, the
- 117 presence of a disease condition associated with PRV2 in Japan known as erythrocytic inclusion
- body syndrome or EIBS has been documented since at least the mid 1980's (Takahashi et al.,

PRV and Associated Disease

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- 119
 1992), suggesting PRV2 has been present in Japan since that time. PRV2 is currently not
 known to occur in British Columbia or in the Eastern Pacific at large.
- 121 **PRV3**
- 122 The third PRV genotypic variant (PRV3) was identified in farmed Rainbow Trout
- 123 (Onchorhynchus mykiss) in Norway and has subsequently been reported in farmed Coho
- 124 Salmon in Chile and in farmed Rainbow Trout in several European countries including Denmark,
- 125 Scotland, Germany, and Italy (Dhamotharan et al., 2018). PRV3 has also been detected in
- Brown Trout (Salmo trutta) from Germany (Kuehn et al., 2018). The historic presence of PRV3
- in these countries is unknown. PRV3 is also not known to occur in British Columbia at this time.

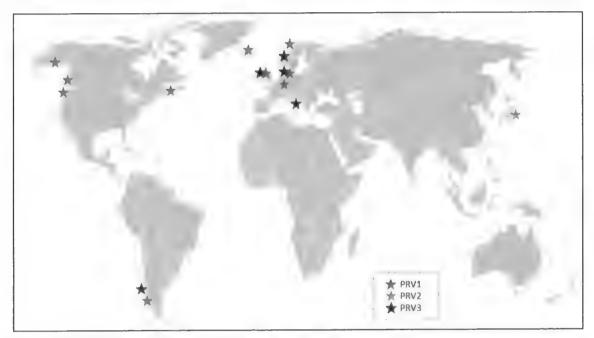


Figure 1. Global detection of PRV in natural and farmed fish populations by country and/or geographic region.

HOST RANGE OF PRV1

Natural infections and controlled laboratory exposure studies indicate PRV1 predominately infects salmonid fish (Table 1). Occasional detection of PRV nucleic acid (RNA) has also been accomplished in some non-salmonid fish species of the North Atlantic and in Eulachon (*Thaleichthys pacificus*) in the Pacific, although none have shown indication of being a primary ecological host and their capacity to replicate or transmit PRV1 remains unknown.

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137 Table 1. Fish species in which PRV1 genetic material has been detected.

Species	Scientific name	Reference
Canada		
Atlantic Salmon	Salmo salar	Kibenge et al. (2013)
Sockeye Salmon	Oncorhynchus nerka	Miller et al. (2014)
Chinook Salmon	Oncorhynchus tshawytscha	Garver et al. (2016b)
Coho Salmon	Oncorhynchus kisutch	Marty et al. (2015)
Pink Salmon	Oncorhynchus gorbuscha	Marty et al. (2015)
Chum Salmon	Oncorhynchus keta	Kibenge et al. (2013)
steelhead Trout	Oncorhynchus mykiss	Kibenge et al. (2013)
Cutthroat Trout	Oncorhynchus clarkii	Kibenge et al. (2013)
Dolly Varden Trout	Salveinus malma	Morton et al. (2017)
Eulachon	Thaleichthys pacificus	Hrushowy (2018)
United States		
Atlantic Salmon	Salmo salar	Warheit (2018)
Chinook Salmon	Oncorhynchus tshawytscha	Purcell et al. (2018)
Coho Salmon	Oncorhynchus kisutch	Marty et al. (2015)
Pink Salmon	Oncorhynchus gorbuscha	Marty et al. (2015)
steelhead Trout	Oncorhynchus mykiss	Purcell et al. (2018)
Norway		
Atlantic Salmon	Salmo salar	Palacios et al. (2010)
Sea Trout	Salmo trutta	Garseth et al. (2013)
Great Silver Smelt	Argentina silus	Wiik-Nielsen et al. (2012)
Atlantic Horse Mackerel	Trachurus trachurus	Wiik-Nielsen et al. (2012)
Atlantic Herring	Clupea harengus	Wiik-Nielsen et al. (2012)
Capelin	Mallotus villosus	Wiik-Nielsen et al. (2012)
Chile		
Atlantic Salmon	Salmo salar	Kibenge et al. (2013)
Coho Salmon	Oncorhynchus kisutch	Godoy et al. (2016)
Iceland		
Atlantic Salmon	Salmo salar	Gunnarsdóttir et al. (2018)
Ireland		
Atlantic Salmon	Salmo salar	Rodger et al. (2014)
Faroe Islands		
Atlantic Salmon	Salmo salar	Markussen et al. (2018)
Germany		
Atlantic Salmon	Salmo salar	Adamek et al. (2018)

CELLULAR TROPISM

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The primary cell type targeted by PRV in salmon is the erythrocyte (red blood cell). Unlike 139 mammals, fish erythrocytes remain nucleated throughout their lifespan and thus possess the 140 cellular components necessary for viral replication during all cellular life stages. PRV is detected 141 with the highest prevalence in blood during most stages of infection relative to all other tissue 142 types tested (Finstad et al., 2014; Garver et al., 2016a; Takano et al., 2016), and of the three 143 types of blood cells (red blood cells, white blood cells and platelets), red blood cells appear to 144 be the only cell type significantly infected (Wessel et al., 2015; Polinski et al., in press). 145 Amplification of both PRV1 protein and genetic material occurs within erythrocytes (Finstad et 146 al., 2014; Wessel et al., 2015) and erythrocytes have repeatedly been used to initiate 147 experimental infections (Wessel et al., 2015; Polinski et al., in press). This provides strong 148 empirical evidence that infectious virus can be generated within this cell type. Secondary 149 infections of cardiomyocytes (heart muscle cells), enterocytes (intestinal absorptive cells) and 150 tissue-resident leukocyte-like cells (presumably macrophages) have also been reported (Di 151 Cicco et al., 2017; Di Cicco et al., 2018). However, it is unclear as to whether or not PRV 152 replication occurs within these cell types, and in vitro experimental infection of Atlantic Salmon 153 heart endothelial (ASHe), epithelial (ASK) and fibroblast (BAASf) laboratory cells lines, as well 154 155 as Rainbow Trout macrophage (RTS11) and approximately 20 other fish laboratory cells lines, 156 have yet to effectively replicate PRV1 under varied environmental conditions (Pham, Bols, Polinski and Garver, unpublished data). One laboratory cell line, GF-1, derived from the fin of 157 orange-spotter grouper, Epinephelus coioides, showed cytopathic effects suggestive of viral 158 replication after being inoculated with a homogenate containing PRV (Mikalsen et al., 2012). 159 However, PRV was not visualized by electron microscopy (Mikalsen et al., 2012) and 160 subsequent attempts to detect amplification of PRV in GF-1 cells using RT-qPCR proved 161 162 negative (Garver et al., 2016b).

INFECTION DYNAMICS

The kinetics of PRV1 as observed in Atlantic Salmon indicates three distinct phases of infection: 164 early entry and dissemination, peak systemic replication, and long-term persistence. In the first 165 (early) phase of infection which typically lasts 2-3 weeks at 12°C, initial host entry, replication 166 and dissemination of the virus into blood cells occurs. It is unknown where PRV first enters host 167 cells, although it is likely through cells of the respiratory (gill) or enteric (gastrointestinal) 168 epithelium as these sites are typical for reovirus entry. Mammalian orthoreoviruses first infect 169 epithelial cells of the small intestine or lung prior to haematogenous dissemination (Boehme et 170 al., 2013); and the recent detection of PRV in intestinal enterocytes (Di Cicco et al., 2018) 171 indicates that a similar course of infection might be followed by PRV. Upon infection, the early 172 replicative phase of mammalian reovirus likely dictates how much virus gets disseminated, 173 ultimately setting the course and overall severity of infection (Lai et al., 2013). This first phase 174 appears equally important with PRV infections and may account for discrepancies in total virus 175 production occasionally observed following laboratory challenge of salmon with different PRV 176 isolations at a similar dose, where a lag in replication of one isolate appears to be the major 177 difference between otherwise identical replication dynamics with blood cells (Polinski et al., in 178 press). A lack of PRV transmission via fish cohabitation at this early stage of infection also 179 suggests that whatever cell type(s) PRV is initially infecting, it is not likely being shed into the 180 environment to a high degree (Polinski et al., in press). 181

In the second (peak) phase of infection that typically lasts 2-3 weeks at 12°C, substantial PRV replication within erythrocytes occurs along with the formation of cytoplasmic viral inclusions (Finstad et al., 2014; Wessel et al., 2015; Haatveit et al., 2017; Polinski et al., *in press*) similar to

- those that develop during mammalian reovirus infection of well-established cell lines (Eichwald et al., 2018). The highest systemic blood loads of PRV occur during this period, and it is when innate virus recognition pathways of the host are most likely to become activated, although this activation can be variable and even nonexistent depending on PRV regional variants [summarized by (Polinski et al., *in press*)]. Cohabitation challenges have shown substantial
- [summarized by (Polinski et al., in press)]. Cohabitation challenges have shown substantia
 virus shedding at this time (Garver et al., 2016a; Wessel et al., 2017).
- In the third (persistent) phase of infection, viral inclusions within erythrocytes disappear and a 191 marked reduction in viral protein production occurs even though large quantities of genomic 192 PRV material remain associated with the erythrocyte cell fraction (Haatveit et al., 2017; Lund et 193 al., 2017; Polinski et al., in press). The ability to recapitulate infectious replication of PRV from 194 late stage infections has been readily accomplished by injecting lysed blood cell material into 195 naïve fish (Polinski et al., in press); however, poor viral transmission has also been 196 demonstrated via cohabitation during this late infectious stage, suggesting natural shedding of 197 virus might be minimal during persistent infections and may even cease entirely over time 198 (Garver et al., 2016a). If heart inflammation occurs, it is typically observed early in the persistent 199 infection phase, although in some instances heart inflammation has occurred just prior to this 200
- phase during the peak of infection (Lund et al., 2017; Wessel et al., 2017; Polinski et al., *in press*). This inflammation can last for weeks to months depending on a number of factors, but ultimately appears to resolve in all cases even though PRV infections continue to persist (Di Cicco et al., 2017; Lund et al., 2017).

PATHOGENICITY

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The perceived capacity of PRV to cause disease in many regards closely mirrors that of Avian 206 orthoreovirus (ARV) in poultry. Namely, its impact varies widely from region to region and its 207 ubiquitous nature is often associated with diseases for which a causative link cannot be 208 established (Jones, 2000). It should be noted that in controlled experimental trials. PRV has (as 209 vet) never caused clinical morbidity or mortality in salmon even during extreme blood infections 210 (Garver et al., 2016a; Takano et al., 2016; Wessel et al., 2017; Polinski et al., in press), nor has 211 it contributed to clinical morbidity or mortality during experimental trials in accompaniment with 212 stressors such as smoltification, viral co-infection, hypoxia, or exhaustive chasing (Garver et al., 213 2016a; Lund et al., 2016; Polinski et al., 2016; Lund et al., 2017; Zhang et al., in press). 214 However, all three genogroups of PRV can at the very least contribute to mild disease states in 215 salmon of variable significance (Olsen et al., 2015; Takano et al., 2016; Wessel et al., 2017; 216 Polinski et al., in press). Thus, although all three genogroups of PRV have pathogenic potential, 217 the virulence of all current known PRV variants appear to be low. 218

PRV is typical for a reovirus, but unlike many other viruses, in that it does not directly lyse the cells it infects (Finstad et al., 2014; Wessel et al., 2015; Polinski et al., *in press*). Rather, the pathogenic potential of PRV likely stems from the killing of infected cells via an adaptive (T-cell mediated) immune response by the host fish (Mikalsen et al., 2012; Yousaf et al., 2012; Zhang et al., *in press*). In other words, PRV itself does not appear to inflict notable damage to host cells, but if host immune T-cells develop an ability to recognize PRV as a foreign invader, infected cells become targeted by these sensitized T-cells for destruction. In some instances this appears to results in immune cells targeting infected cardiomyocytes and cardiac epithelial cells such as during heart and skeletal muscle inflammation (HSMI) (Mikalsen et al., 2012). In others instances, infected erythrocytes have been suggested to become targeted for destruction while passing through the liver or spleen such as possibly during Jaundice anemia of Chinook Salmon (*Oncorhynchus tschawytscha*) (Di Cicco et al., 2018). The mechanisms for initiating these adaptive host responses to PRV (if they can be confirmed) are unknown, and it is also

- 232 unclear why some cell types are more selectively targeted for destruction than others in different
- 233 instances; e.g., cardiomyocytes and not erythrocytes in Atlantic Salmon even though
- 234 erythrocytes are the primary cell type infected (Zhang et al., in press). Recent investigations
- 235 have suggested that these mechanisms are highly variable with regard to the host species, host
- 236 strain (possibly even the individual), and to the PRV isolate involved (Polinski et al., 2018;
- 237 Wessel et al., 2018a). Current knowledge regarding the pathogenic potential of each PRV
- 238 genogroup is outlined below.

PRV1

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- 240 At least one isolation of PRV1 has been demonstrated as a primary etiological component of a
- 241 disease known as HSMI in farmed Atlantic Salmon of Norway (Wessel et al., 2017) and both
- 242 PRV1a and PRV1b have been isolated from HSMI diseased fish in net-pen farm environments
- 243 [for summary, see (Garver et al., 2016a)]. In Norwegian Atlantic Salmon aquaculture, HSMI is
- associated with morbidity, lethargy, and occasional mortality; it is considered one of the most
- 245 significant transmissible diseases affecting the industry (Hjeltnes B et al., 2017).
- 246 The inflammation generated during HSMI is likely mediated by an adaptive cytotoxic T-cell
- 247 response to PRV1 antigen (Mikalsen et al., 2012). This hypothesis is supported by the
- 248 increased presence of cytotoxic T-cells in the heart of HSMI diseased fish in accordance with
- increased transcription of their killing enzymes, e.g., granzyme-A (Mikalsen et al., 2012) and
- 250 that cytotoxic T-cells are also responsible for reovirus-induced heart inflammation in mammals
- 251 (London et al., 1990; Gujar et al., 2010). Nevertheless, the clinical severity of HSMI as seen on
- 252 industry farms in Norway has not been recreated in controlled experimental conditions despite
- 253 the generation of high-load PRV infections with or without hypoxic stress (Lund et al., 2017;
- Wessel et al., 2017) indicating that factors specific to the commercial field environment in
- Norway contribute to HSMI and possibly a heightened cytotoxic T-cell hypersensitivity. This
- 256 heightened disease scenario is likely driven in part by host-specific factors as evidenced by the
- development of a strain of Mowi Atlantic Salmon in Norway that is resistant to HSMI disease but
- 258 not PRV infection (AquaGen, 2017; Emilsen et al., 2017); further supporting that host
- 259 hypersensitivity to PRV may play a critical role in determining the severity of disease.
- 260 In Pacific Canada, PRV1 has been suggested to be a contributing factor in a jaundice/anemia
- syndrome of farmed Chinook Salmon (Di Cicco et al., 2018) as well as severe cardiomyopathy
- in farmed Atlantic Salmon (Di Cicco et al., 2017; Di Cicco et al., 2018). Although it is highly likely
- 263 that PRV can and occasionally does contribute to both conditions, the role for how or if PRV
- acts as the etiological mediator of these relatively rare diseases is far from clear. Specifically,
- 265 neither jaundice/anemia nor severe cardiomyopathy has been successfully transmitted to naive
- 266 Chinook or Atlantic Salmon in laboratory challenge trials in Pacific Canada despite the
- 267 successful passage and development of high-load PRV blood infections within both species
- 268 (Garver et al., 2016b; Polinski et al., in press). This type of passage experiment is critical for
- 269 establishing and identifying pathogenicity of a microbial agent (Fredericks and Relman, 1996),
- and the lack of virulence demonstrated by high-load PRV infections on these occasions
- 271 indicates that other critical etiological factors are necessary to establish these disease
- 272 conditions. This is further supported by the low prevalence of jaundice/anemia or HSMI-like
- 273 cardiopathy compared to the high prevalence of PRV in farmed populations of Chinook and
- 274 Atlantic Salmon in British Columbia, respectively.

PRV2

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In Japan, PRV-2 has been shown to be associated with an anemic condition of farmed Coho Salmon known as erythrocytic inclusion body syndrome or EIBS (Takano et al., 2016). Significant mortality has been historically attributed to EIBS in Japan during farming of Coho Salmon (Takahashi et al., 1992); although experimental challenges with PRV2 have failed to cause mortality (Takano et al., 2016). The mechanisms behind PRV2 pathogenicity are unknown, but as with PRV1, factors specific to field environments appear to exacerbate the severity of disease and associated mortality (Takano et al., 2016). It may be hypothesized from work done with PRV1 that a T-cell mediated hypersensitivity might be responsible for the anemia observed during EIBS in Japan via a mechanism of targeted destruction of infected erythrocytes as they pass through the liver or spleen. Of particular note in considering PRV2 relative to other PRV genogroups is the staggering quantity of virus generated during peak infection (approximately one trillion genomic copies per mL blood) in both experimentally and naturally infected fish (Takano et al., 2016). These quantities appear to be 10 to 1,000 times greater than produced during PRV1 infections of Atlantic Salmon (Garver et al., 2016a; Polinski et al., in press; Zhang et al., in press) and at least 1,000 to 10,000 times higher than the most robust PRV1 infections reported in Pacific Sockeye Salmon (Polinski et al., 2016).

PRV3

PRV3 has been detected in association with an anemic/HSMI-like condition in farmed Rainbow Trout in Europe (Olsen et al., 2015), a jaundice/anemia syndrome in farmed Coho Salmon in Chile (Godoy et al., 2016), and a proliferative darkening syndrome (PDS) in Brown Trout in central Europe (Kuehn et al., 2018). Mortality has resulted from these diseases yet levels vary considerably. Low to moderate mortality occurs in Rainbow Trout suffering from the anemic/HSMI condition (Olsen et al., 2015) while nearly 100% mortality occurs in Brown Trout with PDS (Kuehn et al., 2018). The role that PRV3 plays in the development of these diseases remains unclear, but as for PRV2, it could be speculated to be driven by cytotoxic T-cell recognition. A laboratory study conducted to assess the pathogenicity of a Norwegian variant of PRV3, demonstrated that PRV-3 infections of Rainbow Trout were capable of generating heart inflammation yet failed to recreate anemia. Consequently, the anaemia observed in hatchery outbreaks may be due to a secondary factor triggering a more severe disease as is observed in the field (Hauge et al., 2017). Interestingly, exposure of Atlantic Salmon to PRV3 isolated from Rainbow Trout revealed a capability for the virus to infect both salmonid species, but faster transmission, more notable antiviral response and more prominent heart pathology were observed in Rainbow Trout, suggesting host species-specific factors are important modulators of PRV3 associated disease (Hauge et al., 2017).

REGIONAL VARIATIONS IN VIRULENCE (PRV1)

In Norway, most farmed Atlantic Salmon become PRV positive, but only some develop disease. 311 This does not appear to be dependent on systemic PRV load, and it is not clear why some 312 farms experience high losses due to HSMI while others do not. Nevertheless, clinical outbreaks 313 of HSMI in farmed Atlantic Salmon of Norway are reasonably common (Kongtorp et al., 2004a; 314 Kongtorp et al., 2004b; Kongtorp et al., 2006; Palacios et al., 2010), and laboratory challenge 315 trials have demonstrated a clear ability for PRV to cause severe heart lesions (Wessel et al., 316 2017). Indeed, laboratory challenge trials in Norway routinely generate severe heart lesions in 317 accompaniment with occasional skeletal muscle lesions similar to those observed on HSMI 318 diseased salmon farms (Kongtorp et al., 2004b; Kongtorp and Taksdal, 2009; Mikalsen et al., 319 2012; Finstad et al., 2014; Lund et al., 2017). 320

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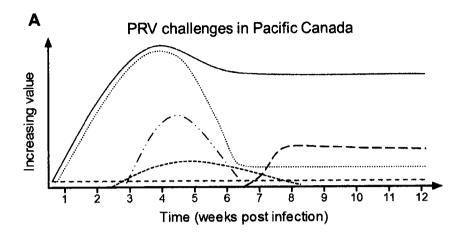
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In Pacific Canada, there is a strikingly divergent relationship regarding PRV and its association 321 with disease. PRV appears to be highly prevalent in farmed Atlantic Salmon of Pacific Canada 322 (Marty et al., 2015); yet, a clinical outbreak of HSMI as described in Norway (Kongtoro et al., 323 2004a; Kongtorp et al., 2004b) has never been reported. Two subclinical farm-level cases of 324 HSMI-like disease have been suggested to date (Di Cicco et al., 2017; Polinski et al., in press). 325 but unlike in Norway, this disease could not be transmitted to naïve fish in a laboratory setting 326 (Polinski et al., in press). Indeed, PRV has failed to cause severe heart lesions or any severity 327 of skeletal muscle inflammation following experimental challenge of Atlantic or Pacific salmon in 328 329 Pacific Canada (Garver et al., 2016a; Polinski et al., in press; Zhang et al., in press). Ongoing laboratory investigations directly comparing PRV isolated in both Norway and the Eastern 330 Pacific have also preliminarily identified that the PRV from the Eastern Pacific is of lower 331 virulence to Norwegian Atlantic Salmon (Wessel et al., 2018a). 332

Host, virus, and environmental factors may all be responsible or contributing factors for this regional altered virulence of PRV. The relative contribution by each of these putative factors is currently unknown; however, there are at least three potentially significant phenotypic dissimilarities between Canadian and Norwegian PRV1 that have been revealed through laboratory challenge trials (Figure 2). First, despite the similarity of Pacific Canada PRV and Norwegian PRV to produce high load viremia, Pacific Canada PRV remains absent from the plasma (Polinski et al., in press) while Norwegian PRV can be detected at high loads in the plasma for up to six weeks following infection (Finstad et al., 2014; Wessel et al., 2017). Second, there is a considerable difference in scale regarding host recognition of PRV. Although direct comparisons between Canadian and Norwegian studies are limited, mean systemic and heart-specific antiviral responses increased no more than fivefold in Pacific Canada studies (Garver et al., 2016a; Polinski et al., in press; Zhang et al., in press) whereas in Norwegian challenges these genes increased 10-50 fold in the blood (Haatveit et al., 2017; Wessel et al., 2017) and more than 100 fold in the heart (Mikalsen et al., 2012). The comparative lack of antiviral response to Pacific Canada PRV compared to Norwegian PRV is further supported by the relative protection PRV has afforded fish challenged with a secondary virus (IHNV) in Norway (Vendramin et al., 2018) but not in Pacific Canada (Polinski et al., 2016). Lastly, in addition to the discrepancies concerning the severity of heart inflammation outlined above, the timing of PRV associated heart inflammation is also different between challenges conducted with PRV from these two countries. Specifically, by either injection or cohabitation exposure of PRV, heart inflammation (prevalence and severity) in Norwegian studies consistently begins around the time of peak systemic PRV load, reaches high severity 1-2 weeks later, and thereafter diminishes (Lund et al., 2017; Wessel et al., 2017). In contrast, increased prevalence of heart inflammation in Pacific Canada challenge trials did not occur until approximately 4 weeks after peak PRV systemic loads were reached and maintained high prevalence (although not severity) for prolonged periods of greater than 6-7 weeks (Polinski et al., in press; Zhang et al., in press). All challenges were conducted at approximately the same temperature ((10-12°C).



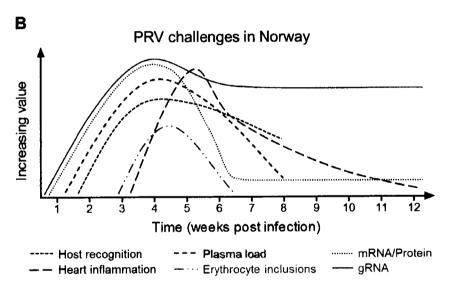


Figure 2. Contrast summary for trends in PRV phenotypic infection dynamics between Norway and Canada laboratory challenge of Atlantic Salmon (taken from Polinski et al., in press). In comparing challenge trials conducted in (A) Pacific Canada (Garver et al., 2016a; Polinski et al., in press; Zhang et al., in press) with results from similar challenge trials conducted in (B) Norway (Mikalsen et al., 2012; Finstad et al., 2014; Haatveit et al., 2017; Wessel et al., 2017).

TRANSMISSION DYNAMICS (PRV1)

Routes of Entry

PRV has been demonstrated to spread horizontally (from fish to fish) during laboratory cohabitation studies where PRV infections become evident in 100% of naïve fish (Garver et al., 2016a; Wessel et al., 2017). The route by which PRV enters naïve hosts remains unclear; however, fecal-oral transmission is a hallmark of many reoviruses and the presence of PRV1 in feces of infected fish (Hauge et al., 2016) coupled with the demonstrated ability of PRV to infect naïve fish via anal intubation (Hauge et al., 2016) suggests fecal-oral transmission is at least one likely route for natural PRV entry. Experimental studies have also generated PRV infections

- following waterborne immersion (Kvamme et al., 2018). Given that direct horizontal transmission 375
- of PRV can readily be accomplished, vector-mediated transmission (e.g., via a multicellular 376
- parasite) would present an unnecessary step in spreading PRV. Currently there is no evidence 377
- to suggest a vector is needed for PRV transmission. 378
- Although the primary mode of PRV transmission is almost certainly horizontal, it is probable, 379
- given the systemic nature of PRV infections, that PRV contamination of sexual fluids permits the 380
- potential for egg-associated vertical (from parent to egg) transmission. Freshwater hatcheries in 381
- both North America and Europe have become infected presumably via this method; however, a 382
- study following a population of Norwegian Atlantic Salmon brood fish and progeny from 2008 to 383
- 2011 found that PRV was not isolated from eggs collected from infected brood fish, suggesting 384
- that vertical transmission, if occurring, is likely playing a minor role in PRV spread, particularly in 385
- 386 natural environments (Wiik-Nielsen et al., 2012).

Shedding

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- PRV infected salmon are considered a main transmission source of virus; yet it remains 388
- unknown as to how long and at what rates PRV is shed from an infected fish. Cohabitation 389
- studies where naïve salmon were introduced at different stages of PRV infection revealed that 390
- Atlantic Salmon recently infected with PRV were capable of transmitting virus but those in 391
- persistent stages of infection had reduced or ineffectual transmission to the naïve cohabitants 392
- (Garver et al., 2016a; Polinski et al., in press). Therefore, it is inaccurate to presume that all 393
- 394 PRV infected Atlantic Salmon are equally contagious and are likely to transmit virus. Laboratory
- studies in Pacific Canada have demonstrated that Atlantic Salmon were highly infectious after 4-395
- 6 weeks of becoming infected with PRV (Garver et al., 2016a) but horizontal transmission was 396
- 397 reduced by 15 weeks (Polinski et al., in press) and could not be accomplished after 44 weeks
- 398 despite the ongoing persistence of PRV (Garver et al., 2016a). Based on these studies, it is
- hypothesized that natural horizontal transmission primarily occurs between 3-15 weeks 399
- following infection, after which the potential for natural shedding becomes severely reduced 400
- (Polinski et al., in press). 401

Environmental stability

- It can be presumed that PRV maintains at least a minimum capacity to survive in water, as 403
- successful waterborne transmission has been demonstrated experimentally. Yet, the extent to 404
- which PRV can remain infectious in the natural marine environment remains unknown. Many 405
- environmental factors such as sunlight, organic load, and indigenous microbial populations can 406
- adversely affect virus stability to varying degrees dependent upon virus type (Pinon and 407
- Vialette, 2018). For instance, viruses surrounded with an envelope are generally more easily 408
- rendered inactive than viruses without an envelope (Fitzgibbon and Sagripanti, 2008). Being 409
- free of an envelope, PRV could be expected to have greater stability than, for example, the 410
- envelope containing aquatic virus infectious hematopoietic necrosis virus (IHNV) which showed 411
- 412 markedly reduced infectivity within hours of being held in natural seawater (Garver et al., 2013).
- However, due to the fact that decay rates are highly conditional upon virus and environmental 413
- factors, survival studies specific to PRV are required to accurately define its duration of 414
- infectivity in seawater. To date, such studies have not been undertaken due to the lack of 415
- conventional culture methodologies to conveniently monitor and evaluate the infectivity of PRV. 416
- Furthermore, suitable proxy data is unavailable as viral stability measurements from culturable 417
- surrogates such as Chum Salmon aquareovirus have not been performed. 418

Infectious potential

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Preliminary evidence using PRV1 from Pacific Canada suggests that ≤10³ PRV particles are 420 sufficient to initiate infection by intra-peritoneal injection in Atlantic Salmon (M. Polinski. 421 unpublished data). The minimum dose required to establish infection by immersion or ingestion 422 is unknown, but the route of virus exposure, the host condition, stock, and species involved are 423 all likely to play a role in the infectious potential of PRV. For example, Sockeye Salmon have 424 exhibited detectable levels of PRV in blood as early as five days post intra-peritoneal injection 425 (Polinski et al., 2016) while Sockeye continually cohabitated with PRV infected Atlantic Salmon 426 did not acquire PRV blood infections until the 4th week of cohabitation (Garver et al., 2016a). 427 Further, sentinel Sockeye Salmon showed substantially lower prevalence and intensity of PRV 428 infections than in sentinel Atlantic Salmon of an equivalent exposure group after 4 weeks of 429 cohabitation (Garver et al., 2016a), indicating that Sockeye Salmon are less susceptible to PRV 430 than Atlantic Salmon and may require a more lengthy exposure period or dose to become 431 432 infected. For newly smolted Pink Salmon (Onchorhynchus gorbuscha) (1 g), waterborne 433 exposure to either 100 or 1,000 purified PRV particles per mL for one hour was insufficient to initiate infection (n=20) while an equivalent dose of 1.000 purified particles administered via 434 435 intra-peritoneal injection established PRV infection in 90% of fish (n=10), suggesting a low susceptibility of Pink Salmon to waterborne infection (Richard, Polinski, and Garver, 436 437 unpublished data). Refractivity to PRV1 by immersion has also been preliminarily demonstrated 438 in Sea Trout (Salmo trutta) relative to Atlantic Salmon in Norway (Kvamme et al., 2018). It is currently unknown if these reduced susceptibilities are dose and/or duration dependent. 439

Farmed-to-wild salmon transmission

Given the linkage with PRV to HSMI in Norwegian Atlantic Salmon farming, investigations have been conducted in Norway to evaluate the transmission of HSMI and PRV between neighboring farms and to wild fish populations. Sequence comparisons of PRV variants collected from farm and wild salmon in Norway revealed that PRV genotypes are similar regardless of host origin, suggesting that virus exchange is occurring between wild and farmed populations in Norway (Garseth et al., 2013; Madhun et al., 2018). However, neither the directionality nor the mechanism(s) responsible for exchanging PRV between farmed and wild populations are currently known. It has been postulated that interactions between wild and escaped farmed salmon, specifically when wild salmon migrate through aquaculture areas, may serve as potential mechanisms of virus perpetuation (Garseth et al., 2013). Nevertheless, comparisons of PRV prevalence in wild adult salmon from regions of northern Norway with differing farming intensity and disease frequency showed no association between salmon farming and the prevalence of PRV infection in wild salmon (Madhun et al., 2018).

In western North America, the high genome homology between PRV1 isolates of farmed and 454 wild salmon (Siah et al., 2015) suggests the presence of a common reservoir and/or exchange 455 456 of virus between wild and farmed populations. Yet the contribution of salmon farms to potentially 457 exchange PRV with wild fish is unclear. One study has hypothesized salmon farms may influence PRV prevalence in wild Pacific salmon after identifying a higher prevalence of PRV in 458 459 wild salmon with a "high" exposure probability to salmon farms than in fish sampled from "low" farm-exposure regions (Morton et al., 2017); although it must be noted that the categorization 460 for low and high farm exposure used in this study is highly speculative. In contrast, a study that 461 compared prevalence of PRV in Coho Salmon from Alaska (an area devoid of open net pen 462 salmon aquaculture) to Coho Salmon from British Columbia (where salmon farms are present) 463 identified no significant difference in PRV prevalence, suggesting salmon farming was 464 contributing negligibly to PRV prevalence in these wild Coho stocks (Marty et al., 2015). 465

- Chinook Salmon also screened for PRV in Alaska (Purcell et al., 2018) similarly showed 466
- analogous prevalence and stock variability for PRV detection to Chinook Salmon of British 467
- Columbia (Marty et al., 2015) (Table 2); also suggesting that salmon farms are having minimal 468
- direct impacts to PRV prevalence in Chinook of the Eastern Pacific. Undoubtedly a multitude of 469
- factors are responsible for influencing PRV prevalence in wild salmon, which is clearly evident 470
- by the fact that PRV prevalence varies considerably across host species and even between 471
- cohorts of a particular species (Purcell et al., 2018). Consequently, longer time scale monitoring 472
- efforts in conjunction with molecular epidemiology studies are needed to fully appreciate the 473
- drivers of PRV infection in salmon population of western North America. 474

PREVALENCE IN WESTERN NORTH AMERICA 475

- Molecular diagnostic screening has been applied in numerous surveillance programs that have 476
- identified the presence of PRV among farmed and wild salmon collected over the geographic 477
- range spanning Alaska to Washington. Analyses of archived salmon samples from 1974-2008 478
- from British Columbia also revealed a long-term and common presence of PRV1 in the Eastern 479
- Pacific with positive detections identified in samples dating back to 1987 and possibly as early 480
- as 1977 (Marty et al., 2015). Both farmed and wild fish stocks have been shown to become 481
- 482 infected.

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Farmed Atlantic Salmon

- 484 Once PRV becomes present on a salmon farm, it is expected to reach 100% prevalence within
- the population (Di Cicco et al., 2017; Polinski et al., in press). In a temporal study of PRV at one 485
- Atlantic Salmon farm site in British Columbia, PRV was first detected 3 to 4 months following 486
- seawater entry and peaked at 100% several months later (Di Cicco et al., 2017). A second 487
- study also identified 100% PRV prevalence at a different British Columbia Atlantic Salmon farm 488
- site after fish had spent 3 months at sea (Polinski et al., in press). More recently, a sampling 489
- survey of dead or dying fish collected in all aquaculture zones of BC demonstrated that time-at-490
- sea was a significant predictor for the detection of PRV in Atlantic Salmon with prevalence 491
- increasing up to 18 month post seawater entry and declining thereafter (Laurin et al., 2019). 492
- Additionally, current ongoing research examining PRV prevalence on 13 Atlantic Salmon farms 493
- spread across British Columbia found that fish at all 13 sites became infected with PRV with a 494
- general onset within 100 and 200 day post seawater entry that was independent of location or 495
- time of stocking. Further, following initial infection, all 13 farms reached 100% infection 496
- prevalence within 100 days of first detection (Polinski and Garver, unpublished data). 497

Wild Pacific salmon

- Either through experimental or natural infection, all five species of North American Pacific 499
- salmon have been shown to be capable of supporting PRV infections; however, surveys of wild 500
- Pacific salmon demonstrate that PRV prevalence can vary dramatically between species and 501
- stock. Across multiple independent surveys of Pacific salmon and trout, PRV was consistently 502
- detected at higher prevalence in Chinook and Coho salmon as compared to Chum (O. keta). 503
- Pink, Sockeye, and steelhead Trout (O. mykiss). The overall prevalence for Chinook and Coho 504
- salmon identified within these studies reached approximately 6% and 9%, respectively, while 505
- PRV prevalence in Pink Salmon remained below 4%, Sockeye around 1.4%, and Chum as well 506
- as steelhead less than 1% (Table 2). 507

Table 2. PRV1 prevalence in North American Pacific salmon and trout species sampled in Alaska, British Columbia, and Washington. Numbers in parentheses represent the PRV positive fish per total number of fish sampled.

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			PRV1 sur	PRV1 surveillance studies	ies		
Species	(Marty et al., 2015)	(Purcell et al., 2018)	(Morton et al., 2017)	S. Johnson unpublished	Studies using Fluidigm BioMark™ assayª	Unpublished student theses ^b	Overail
Sockeye Salmon	0.3% (1/371)	0.0% (0/394)	9.3% (21/225)	0.0% (0/717)	1.6% (67/4215)	1.0% (8/771)	1.4% (97/6693)
Chinook Salmon	8.8% (6/68)	4.0% (19/480)	34.3% (34/99)	4.4% (54/1232)	2.8% (9/325)	2.4% (1/41)	5.5% (123/2245)
Coho Salmon	7.6% (9/118)	11.8% (56/473)	26.1% (18/69)	4.5% (16/356)	1.7% (1/61)	I	9.3% (100/1077)
Pink Salmon	0.0% (0/313)	0.4% (1/243)	25.0% (27/108)	0.0% (0/70)	1	1	3.8% (28/734)
Chum Salmon	0.0% (0/101)	0.0% (0/287)	7.5% (5/67)	0.0% (0/135)	1	I	0.8% (5/590)
Steelhead Trout	ı	0.3% (1/375)	28.6% (4/14)	I	1	1.0% (3/303)	0.9% (5/553)
Cutthroat Trout	ı	1	50.0%(8/16)	ŀ	ı	trout	ı
Dolly Varden Trout	ı	ı	10.0% (1/10)	ı	ı	combined	i

a (Jeffries et al., 2014; Miller et al., 2014; Bass et al., 2017; Teffer et al., 2017; Nekouei et al., 2018; Teffer et al., 2018; Thakur et al., in press)

511 b(Furey, 2016; Healy, 2017; Hrushowy, 2018; Stevenson, 2018)

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PRV and Associated Disease

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Specific to Sockeye Salmon, 12 independent studies cumulatively indicate that the majority of 513 samples positive for PRV nucleic acid were collected from returning adults (Table 3). A 514 cumulative 0.3% (12/3911) of fry and juvenile fish were positive for PRV whereas 2.9% 515 (85/2912) of returning adults were positive. This data also suggests that most PRV infections 516 occurred at sea. PRV was detected on or in out-migrating smolts collected at the mouth of 517 Queen Charlotte Strait and within the southern Queen Charlotte Sound (after presumed 518 northward migration through the Discovery Islands/Johnson Strait) at a prevalence of 0.8% 519 (7/833), whereas fry and parr had a nominally lower prevalence of 0.4% (4/1072) in freshwater, 520 with most detections (3) occurring in a population of fry from Oweekeno Lake that is not 521 associated with the Fraser River (Table 3). Similarly, the majority of PRV detections in adult 522 Sockeye Salmon (63/85 total positives) occurred in one study which screened gill biopsies of 523 returning adult fish migrating southwards through the Johnston Strait/Discovery Islands (Miller et 524 al., 2014). Interestingly, liver samples taken at the same time of gill biopsies as well as 525 subsequently in the Fraser River were negative for PRV: suggesting that the PRV on or in the 526 gill tissues of these fish did not represent systemic infections nor did systemic infections likely 527 develop before returning fish reached their spawning grounds. 528

Within the Fraser River, PRV has been detected in at least five stocks of Sockeye Salmon (Table 4), although sampling for many stocks has been limited and the single Nadina River sample positive for PRV nucleic acid was considered questionable by the authors (Marty et al., 2015). Further, it should again be noted that 63/68 positive PRV detections occurred as a result of gill biopsies taken from returning adults passing through the Johnstone Strait/Discovery Islands which did not appear to develop systemic infections (Miller et al., 2014).

Table 3. Detection of PRV in Sockeye Salmon of Alaska, British Columbia, and Washington by life stage. Numbers in parentheses represent the PRV positive fish per total number of fish sampled. Cumulative detection specific to Fraser River Sockeye Salmon (FRSS) stocks (where identified) is also presented; the 29 adult fish sampled in saltwater by Morton et al. are of unknown (possibly Fraser River) origin but not incorporated into the FRSS summary.

Sockeye Salmon PRV prevalence

Data Source	Fry	Parr/smolt		Adults	
	Freshwater	Freshwater	Saltwater	Saltwater	Freshwater
Marty et al. (2015)		0/30			1/341
Purcell et al. (2018)					0/394
Johnson (unpublished)		0/344	0/373		
Morton et al. (2017)		1/1	3/90	0/29	17/105
Miller et al. (2014)			1/165	64 ¹ /531	1/498
Teffer et al. (2017)					0/112
Thakur et al. (in press)					0/652
Nekouei et al. (2018)		0/896	1/1110		
Jeffries et al. (2014)		0/228			0/23
Stevenson (2018)		0/300			
Furey (2016)		0/80			
Hrushowy (2018)	3/89		3/205		2/97
Totals	3.4% (3/89)	0.1% (1/1879)	0.4% (8/1943)	11.4% (64/560)	0.9% (21/2222)
Totals (FRSS only)		0.1% (1/1505)	0.2% (2/1258)	12.1% (64/531)	1.3% (19/1431)

163/155 detections of PRV from gill biopsies but 0/57 detections in liver tissues collected at same location

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Table 4. Distribution of PRV detection across Fraser River Sockeye Salmon stocks (Jeffries et al., 2014; Miller et al., 2014; Marty et al., 2015; Furey, 2016; Morton et al., 2017; Teffer et al., 2017; Nekouei et al., 2018; Stevenson, 2018).

Otrack and a second for BDV	PRV screening results		
Stock screened for PRV	Juveniles	Adults	
Bowron	0/9		
Cultus	1/62		
Weaver	0/8		
Portage	0/35		
Early Stuart, Late Stuart & Misc.1	0/4	1/191	
Quesnel	0/22	0/297	
Horsefly	0/148		
Mitchell	0/119		
Blue Lead	0/1		
Wasko-Roaring	0/16		
Nahatlatch River	0/16		
Fennell	0/1		
Thompson	0/75		
Raft	0/18		
Upper Barrier	0/3		
Birkenhead	0/77	0/11	
Scotch	0/72	0/8	
Seymour	0/134		
Adams	1/370	0/2	
Shuswap	0/398	49/304	
Eagle	0/6		
Little	0/5		
Nadina	0/60	1 ² /60	
Dolly Varden	0/86		
Chilliwack Lake	0/34		
Stellako	0/137	0/10	
Gates	0/65	0/19	
Big Silver	0/4		
Pitt	0/79		
Harrison		0/103	
Chilko	0/1018	15/250	

¹ This includes juvenile fish sampled from Sandpoint Creek, Five Mile Creek, Middle River, and Dust-Sinta Creek (n=1 per stock).

² Positive detection of PRV nucleic acid in only one of two technical replicates which was noted as inconclusive by the authors (Marty et al., 2015).

548 CARDIOPATHY OF SALMON

CAUSATIVE FACTORS

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Cardiopathy refers to diseases of the heart that affects contractive functions and decreased capacity to circulate blood. These diseases have many causes and, in association with the global production of farmed salmon, a variety of cardiopathies have been described. Some occur as a result of non-transmissible conditions such as during cardiac remodeling and expansion due to chronic hypoxia stress (Simonot and Farrell, 2007) or as a result of congenital mutation (Becker et al., 2011). However, cardiopathy can also occur due to infectious and transmissible microbes. Specific to salmon, at least eight infectious agents are known to cause cardiopathic disease, although high-load systemic infections of virtually any moderately virulent pathogen has the potential to inflict damage to heart tissues:

- Renibacterium salmoninarum (Bruno, 1986)
- Piscirickettsia salmonis (Olsen et al., 1997)
- Kudoa thyrsites (Moran et al., 1999)
- Ichthyophonus hoferi (Kocan et al., 2006)
- Yersinia ruckeri (Rucker, 1966)
- Salmonid alpha virus (SAV) (Wiik-Nielsen et al., 2016)
- Piscine myocarditis virus (PCMV) (Haugland et al., 2011)
- Piscine othoreovirus (PRV) (Wessel et al., 2017)

567 Of these, six are endemic to British Columbia: I. hoferi, K. thyrsites, P. salmonis, R.

568 salmoninarum, Y. ruckeri and PRV. In the event that the causative agent of a heart disease is

not clearly identifiable, a diagnosis of idiopathic cardiopathy is assigned.

PREVALENCE AND IMPACT IN BRITISH COLUMBIA

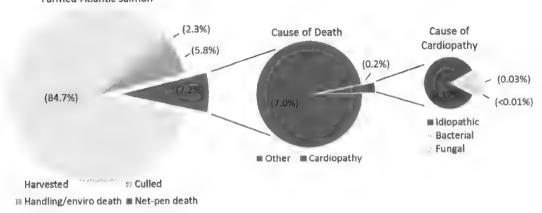
General cardiopathy

Mild cardiopathy is prevalent in farmed salmon of British Columbia; however, severe cardiopathy impairing heart function is rare. Between 2006 and 2018, the Fish Health Auditing and Surveillance Program (FHASP) conducted by DFO Aquaculture Management Division has evaluated all major organs of nearly 6,000 Atlantic and 800 Pacific (majority Chinook; some Coho) salmon net-pen farming mortalities by histopathology including heart tissues. Mild to moderate cardiopathy occurred in 61% of Atlantic and 41% of Pacific salmon mortalities sampled during this period. However, this cardiopathy, mainly epi- and endocarditis, does not compromise heart or respiratory function (Lund et al., 2017; Zhang et al., *in press*) and is not expected to adversely affect salmon health. Moderate to severe cardiopathy with a putative ability to negatively affect heart functioning was diagnosed in 7% and 3% of Atlantic and Pacific salmon mortalities, respectively. The severity was sufficient to be suggested as a putative cause or contributing factor to death in less than 3% of both Atlantic and Pacific salmon species (Figure 3). These percentages are representative of sites specific to the Discovery Islands region and are consistent with other independent studies which have corroborated the relatively widespread occurrence of generally mild cardiopathy in British Columbia salmon with little

evidence for its contribution to morbidity or mortality over the past decade (Marty et al., 2015; Di

Cicco et al., 2017). This is also consistent with previous diagnoses of prevalence for severe cardiopathy in farmed salmon from the early 1990's (Brackett et al., 1990; Brackett et al., 1991; Brackett and Newbound, 1992; Brackett et al., 1992); suggesting that cardiopathy has likely caused or contributed to less than 0.4% cumulative mortality in farmed salmon in BC over the past 25 years. The proportion of this cardiopathy that is attributable to infectious diseases and specifically PRV is unknown, although multiple transmissible and non-transmissible factors are indicated to be involved in addition to PRV (Figure 3).

Farmed Atlantic salmon



Farmed Pacific salmon

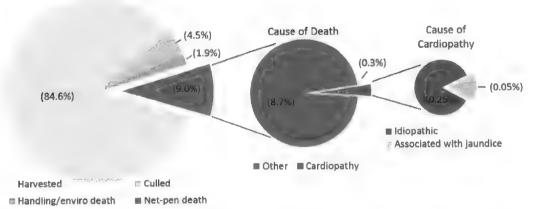


Figure 3. Cardiopathy as a marker of death in farmed salmon of British Columbia. Cumulative percent mortality of stocked fish per annum presented in left pie charts are extrapolated from the mean monthly mortalities reported across salmon farming industries between 2012-2018. Putative cause of death diagnoses from net-pen mortalities not associated with culling, handling, or environmental causes (e.g., low dissolved oxygen) is presented in the center pie charts based on FHASP data collected between 2006 and 2018. The putative causes of cardiopathy in these instances are presented in the right pie charts. All percentages are relative to total number of net-pen Atlantic or Pacific salmon stocked per annum during this time period.

- The prevalence of cardiopathy in wild Pacific salmon is relatively unknown; however, a survey of
- 204 wild salmon of British Columbia in 2013 that included Pink, Chum, Chinook, Coho, and
- Sockeye salmon diagnosed mild cardiopathy in 12 fish (5.9%) but failed to identify significant
- (severe) cardiopathic disease (Marty et al., 2015). Similarly, severe cardiopathy that occurs in
- 610 farmed Atlantic Salmon in Norway (e.g., HSMI, CMS and PD) has not been detected in wild
- Atlantic Salmon (Garseth et al., 2013), suggesting environmental components specific to
- 612 intensive culture likely enhance the prevalence and severity of cardiopathy in salmon.

HSMI

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- The term HSMI, although foundationally descriptive, has evolved considerably in meaning over
- the past decade. Before a causative agent was known, the original diagnosis of HSMI was
- 616 founded on a set of distinct clinical disease characteristics in Norwegian Atlantic Salmon farms
- during episodes of morbidity and/or mortality for which histopathology was used to confirm and
- 618 differentiate this condition from other similar diseases; e.g., pancreatic disease or
- 619 cardiomyopathy syndrome. By this original case definition, HSMI has never been reported in
- 620 British Columbia:
- 621 "Affected fish are anorexic and display abnormal swimming behaviour. Autopsy findings typically
- 622 include a pale heart, yellow liver, ascites, swollen spleen and petechiae in the perivisceral fat.
- 623 Diagnosis of HSMI is presently based on histological examination. HSMI is characterised by
- 624 extensive panmyocarditis and myositis, particularly involving red skeletal muscle. Morbidity may
- be very high, while mortalities are variable and may reach 20% in affected cages." (Kongtorp et
- 626 al., 2004a).
- 627 Following the discovery of PRV in association with HSMI in Norway in 2010 (Palacios et al.,
- 628 2010) and the subsequent demonstrated ability for PRV to cause severe heart inflammation
- 629 (Wessel et al., 2017), the diagnosis for HSMI, although still exclusively based on histopathology,
- 630 is generally accepted to be initiated by PRV. Many subclinical infections of HSMI have now
- been diagnosed in Norway, some even without the evidence of skeletal muscle inflammation,
- and although environmental and/or host contributing factors may explain the often exacerbated
- 633 severity of HSMI in a field relative to laboratory setting, PRV appears to be the sole infectious
- agent associated with the unique set of histopathological criteria that defines HSMI in Norway
- 635 (Palacios et al., 2010; Wiik-Nielsen et al., 2016; Wessel et al., 2017). To our knowledge, HSMI
- has never been used to classify a disease state in Norway where PRV has been confirmed to
- 637 be absent.
- Two recent studies from Pacific Canada have also used the term HSMI to classify subclinical
- 639 heart disease of farmed Atlantic Salmon based on histopathology in accordance with their own
- definitions similar to those previously reported in Norway namely, moderate to severe heart
- inflammation sometimes accompanied by skeletal muscle inflammation (Di Cicco et al., 2017; Di
- 642 Cicco et al., 2018). Although the presumed commonality for the heart and skeletal muscle
- lesions in these Canadian studies relative to HSMI diagnosed in Norway is the causation by
- PRV, there is far less evidence in Canada to support that PRV is indeed the key component for
- 645 initiating this relatively rare disease state; particularly given that these modified definitions have
- occasionally been observed in the absence of PRV (Marty et al., 2015; Di Cicco et al., 2018).
- 647 Consequently, if HSMI diagnosis is based solely on histopathological heart lesions which can
- occur in the absence of PRV, then PRV cannot be assumed to be *the* causative agent of the
- disease, but rather one of multiple stand-alone or synergistic putative factors. Thus, if using the
- definition proposed by Di Cicco et al. (2017), HSMI in British Columbia can likely be used
- 651 interchangeably with the terms 'moderate to severe cardiopathy' or 'idopathic cardiopathy' as

PRV and Associated Disease

described above. Throughout this review, we use the term HSMI only in cases which fit those 652 described by Wiik-Nielsen et al (2016) where PRV appears to be the most likely primary 653 causative factor. 654

ANEMIA OF SALMON

CAUSATIVE FACTORS

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Anemia is a condition marked by a deficiency in red blood cells and/or haemoglobin that results in a reduced ability for blood to transport oxygen. Many factors can cause or contribute to anemia in fish including nutrient deficiencies, toxic agents and infectious pathogens (Witeska, 2015). Specific to salmon, at least eight pathogenic organisms (including viruses, bacteria, and external parasites) are known to directly or indirectly contribute to anemia although this is almost certainly not a comprehensive list:

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- Infectious salmon anemia virus (ISAV) (McBeath et al., 2015) 663
- Infectious hematopoietic necrosis virus (IHNV) (Amend and Smith, 1975) 664
- Piscine orthoreovirus (PRV) (Takano et al., 2016) 665
- Aeromonas sp. (Řehulka, 2002) 666
 - Flavobacterium columnare (Řehulka and Minařík, 2007)
- 668 Vibrio anguillarum (Harbell et al., 1979)
- Ichthyophthirius multifiliis (Abdel-Hafez et al., 2014) 669
- Tetracapsuloides bryosalmonae (Hoffmann and Lommel, 1984) 670

Of these, there are five relevant to salmon of British Columbia that reside in saltwater: IHNV, 671 PRV. Aeromonas sp. F. columnare and V. anguillarum. However, although PRV is listed here, it 672 must be noted that the only PRV isolate to induce anemia in salmon through experimental 673

infection to date is that of PRV2 from Japan (Takano et al., 2016). 674

It also must be acknowledged that the measures used to assess anemia (erythrocyte count, haemoglobin concentration and hematocrit) are at best indirect measures because they do not necessarily imply a lack of sufficient oxygen delivery. This is highly important when considering that, unlike for mammals, these measures can fluctuate substantially in healthy populations of fish. In salmon, the packed erythrocyte volume (hematocrit) can vary as much as 40% between

679 individuals within a single cohort population (i.e., hematocrit ranging from 40-65% of total blood 680

volume) without significant correlation to respiratory functioning (Zhang et al., in press). For 681

salmon, it has been suggested that functional anemia occurs when hematocrit drops below 682 approximately 20-25% total blood volume (Simonot and Farrell, 2007; Clauss et al., 2008).

683 although this estimate will likely vary depending on a variety of environmental and host-specific 684

factors. Thus, clinical symptoms such as lethargy or other signs of morbidity and/or mortality are 685

important characteristics for identifying fish which are truly anemic (i.e., have a loss in 686

respiratory function) relative to those which may have a reduced hematocrit or haemoglobin 687

relative to what is 'typical' for the species but remain physiologically uncompromised. 688

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IMPACT AND PREVALENCE IN BRITISH COLUMBIA

Unexplained anemia (i.e., with the potential to be caused by an unknown pathogen such as PRV) is rarely documented in salmon of British Columbia. There were no veterinary diagnoses indicative of anemia in farmed Atlantic Salmon made as part of the FHASP within DFO between 2011 and 2017 that included 663 site visits and 4,344 sampled specimen carcasses. There were also no diagnoses of anemia in farmed Coho Salmon during this period (17 site audits involving 75 collected specimens). In farmed Chinook Salmon, a condition referred to as Jaundice Syndrome was diagnosed by the FHASP veterinarian for 7 out of 479 carcasses (1.5%) in 5 of 95 site audits during this seven year period. Jaundice Syndrome is characterized by yellow discoloration of the skin resulting from excessive bilirubin in the blood due to red blood cell breakdown. Substantial red blood cell breakdown is needed to cause laundice and can therefore be used as a proxy for identifying current or recent anemia. The prevalence of jaundice/anemia reported during the FHASP is similar to that reported previously in farmed Chinook Salmon of BC (< 1.5% jaundice-associated mortality per production cycle) that appears to have a seasonal (cold water temperature) component (Garver et al., 2016b). This seasonality is at least partially substantiated by a focused study involving 210 FHASP samples collected from Chinook Salmon in 2011-2013 by Di Cicco et al. (2018), where the authors noted what they classified as jaundice syndrome based on their own definitions using histopathology (a more liberal classification than previously used by government or industry veterinarians) in 14 fish (6.7%) that was restricted to two specific sampling events. The occurrence of unexplained anemia in wild Chinook Salmon or any other Pacific salmon species in British Columbia is unknown.

RELATIONSHIP OF PRV AND DISEASE IN BRITISH COLUMBIA

ATLANTIC SALMON

Experimental challenge trials using PRV1 in Pacific Canada Atlantic Salmon have resulted in 713 extreme PRV blood infections, but either failed to generate notable pathology (Garver et al., 714 2016a) or induced only minor to moderate heart inflammation - specifically, epi- and 715 endocarditis (Polinski et al., in press; Zhang et al., in press). Further, the increased prevalence 716 of minor heart inflammation induced by PRV (when it occurred) in these experiments was 717 demonstrated to be inconsequential to normal heart and respiratory functioning (Zhang et al., in 718 press). However, a correlation of PRV to moderate to severe heart inflammation has been 719 proposed in a field environment based on a longitudinal study of one farm site with a high 720 transient presence of moderate to severe cardiopathy (Di Cicco et al., 2017). The visualization 721 722 of PRV in diseased hearts in this study in conjunction with activation of host cellular antiviral 723 response pathways strongly suggested that PRV was contributing to the severity of cardiopathy observed. Thus, taken together, these studies suggest that PRV has the potential to exacerbate 724 instances of severe cardiopathy in net-pen farmed Atlantic Salmon in British Columbia in some 725 726 case and may be a contributing etiological factor in establishing at least some instances of this relatively rare disease. 727

PACIFIC SALMON

Two PRV experimental challenge studies have been published exploring the disease causing potential of PRV1 to Sockeye Salmon; both failed to identify an association with PRV and disease (Garver et al., 2016a; Polinski et al., 2016). A third study has also recently been completed with Sockeye Salmon that failed to generate anemia or notable pathology in heart,

kidney, or liver tissues of infected fish; and, in the same manner as assessing physiological impacts of PRV on Atlantic Salmon (Zhang et al., in press), demonstrated these infections to be inconsequential to Sockeye physiological respiratory functioning (Polinski et al., manuscript in preparation). For adult Chilko or Shuswap Sockeye Salmon returning to the Fraser River, it was identified that the presence of PRV on or in the gills of fish migrating through Discovery or Juan De Fuca sea channels had no significant effect on the likelihood that they would reach their spawning grounds (Miller et al., 2014). Coho Salmon challenged with PRV harvested from infected farmed Atlantic Salmon in British Columbia also failed to acquire notable pathology or anemia despite attaining substantial PRV blood infections (Winton et al., manuscript in preparation). Lastly, experiments attempting to passage jaundice syndrome in Chinook Salmon in association with PRV failed to passage the disease despite successfully passaging PRV (Garver et al., 2016b). Nevertheless, similar to field observation of PRV contributing to severe cardiopathy in Atlantic Salmon, PRV has been visualized in diseased tissues of farmed Chinook Salmon experiencing Jaundice Syndrome (Di Cicco et al., 2018) which would suggest that PRV is capable of contributing to jaundice/anemia and may be part of a more complex aetiology for establishing this rare disease state in Chinook Salmon.

749 DISEASE PREVENTION

In British Columbia, there has been no data to suggest PRV adversely affects aquaculture production of salmon. In Norway, however, HSMI is considered one of the most significant infectious diseases affecting Atlantic Salmon aquaculture (Hjeltnes B et al., 2017; Marine Harvest, 2017) and a number of strategies are being explored to mitigate this disease. Two experimental vaccination studies have been conducted; one using a formalin killed PRV vaccine (Wessel et al., 2018b) and one using a DNA vaccine expressing the non-structural proteins of PRV (Haatveit et al., 2018). Both demonstrated moderate protection against HSMI, although neither were protective against PRV infection. In addition to vaccination, work towards establishing a "HSMI-resistent" Atlantic Salmon strain has been undertaken (AquaGen, 2017), although similar to the vaccines mentioned above, these fish do not appear to be refractory to PRV but rather only HSMI (Emilsen et al., 2017). Furthermore, use of specific feed formulations, similar to the other treatments, has shown promise at reducing the effects of HSMI primarily through dietary immunomodulation but is not successful at eliminating PRV infections (Grammes et al., 2012; Martinez-Rubio et al., 2012).

764 SUMMARY

There has been a great deal of knowledge gained regarding the virology and ecology of PRV following its discovery nine years ago; and much of that knowledge has direct or indirect relevance for assisting in the assessment of risk to Fraser River Sockeye Salmon posed by the occurrence of PRV on Atlantic Salmon farms. The most critical research findings that can aid this risk assessment are summarized here:

- PRV is ubiquitous and highly prevalent in net-pen farmed salmon of British Columbia; it
 is also widely distributed in wild Pacific salmon but with less prevalence and
 species/stock-specific variation.
- Farmed and wild salmon of British Columbia appear most likely to become infected with PRV as adults in saltwater although freshwater infections of fry/parr can and have occurred.

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- Infections with PRV in British Columbia generate high-load blood infections in both
 777 Atlantic and Pacific salmon species but have failed to generate notable (moderate to
 778 severe) disease following experimental infection in any species challenged (Sockeye,
 779 Chinook, Coho, Pink and Atlantic).
 - PRV is of lower virulence to Atlantic Salmon in British Columbia relative to PRV infections of Atlantic Salmon in Norway; both host and virus specific factors are likely involved in this altered virulence.
 - Infections of PRV in Atlantic and Sockeye salmon of British Columbia have been demonstrated as inconsequential to respiratory function in the absence of notable (moderate to severe) pathology.
 - The severity of a systemic PRV infection is not indicative of whether a salmon will or will not develop a notable disease.
 - PRV may contribute to or be a possible etiological component of severe heart inflammation in farmed Atlantic Salmon or jaundice/anemia syndrome in farmed Chinook Salmon in British Columbia; both conditions appear rare and likely have complex etiologies.
 - There is currently no evidence to suggest that PRV causes disease in Sockeye Salmon, which appear less susceptible to infection relative to Atlantic Salmon in British Columbia.

Despite substantial gains in our understanding about PRV, there are also knowledge gaps concerning PRV virology and ecology that leave critical uncertainties. The environmental source(s) and transmission potential of PRV in ocean environments are unknown. Specifically, there is no current data on environmental shedding (quantity or duration) or the minimum exposure load (quantity or duration) to establish an infection in any salmon species. There is also a current lack of understanding for why PRV can show higher virulence in some instances compared to others. Lastly, in the instances where PRV has been linked to disease in farmed salmon, it is as yet unclear as to whether all host, environment, and viral specific factors of these diseases can manifest in the natural environment in British Columbia.

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Assessment of the risk to Fraser River Sockeye Salmon due to Piscine Orthoreovirus (PRV) on Atlantic Salmon farms in the Discovery Islands area, British Columbia

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the Secretariat.

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GLOSSARY

Acute: characterized by a short and relatively severe course

Cardiopathy: diseases of the heart (including all vascular, epicardial, and myocardial conditions) that affect contractive functions and decrease the capacity of the heart to circulate blood

Cardiomyopathy: disturbance or disease or the heart muscle

Chronic: a disease condition that is persistent or long lasting

Clinical: outward appearance of a disease in a living organism

Disease: condition in which the normal function or structure of part of the body or a bodily

function is impaired

Epidemiological unit: a group of animals that share approximately the same risk of exposure to a pathogenic agent with a defined location

Fish Health Event (FHE): a suspected or active disease occurrence within an aquaculture facility that required the involvement of a veterinarian and any measure that is intended to reduce or mitigate impact and risk that is associated with that occurrence or event

Fomite: an inanimate object capable of transmitting a disease (e.g., contaminated net or boat)

Genogroup: phylogenetically distinct group or cluster

Horizontal transmission: fish to fish transfer of a pathogen

HSMI: a heart and skeletal muscle inflammatory disease of farmed Atlantic Salmon characterized by cellular epicarditis, moderate-to-severe inflammation and necrosis (especially in the ventricle with inflammation predominant) where inflammation of the red skeletal muscle is a supportive finding; and PRV is evidenced to be a major etiological factor

HSMI-like: inflammatory heart disease as characterized for HSMI but with questionable etiology

Incubation period: time between host infection by a pathogenic organism and appearance of the first signs of disease

Infection: growth of pathogenic microorganisms in the body, whether or not body function is impaired

Infection pressure: concentration of infective pathogens in the environment of susceptible hosts

Mortality event: fish mortalities equivalent to 4000 kg or more, or losses reaching 2% of the current facility inventory, within a 24 hour period; or fish mortalities equivalent to 10,000 kg or more, or losses reaching 5%, within a five day period

Outbreak: the occurrence of one or more cases of a disease than would normally be expected in an epidemiological unit over a given period of time

Prevalence: number of hosts infected with a pathogen (*infection prevalence*) or affected by a disease (*disease prevalence*) expressed as a percentage of the total number of hosts examined for that pathogen (or disease) in a population at a specific time

Subclinical: insufficient signs to cause classical identifiable disease

Sublethal: insufficient to cause death

Susceptible species: a species in which infection has been demonstrated by the occurrence of natural cases or by experimental exposure to the pathogenic agent that mimics natural transmission pathways

Vector: living organism that has the potential to transmit a disease, directly or indirectly, from one animal or its excreta to another animal (e.g., personnel, wildlife, etc.).

ABSTRACT

(To come)

Évaluation du risque pour le saumon rouge du fleuve Fraser que représente le transfert du orthoréovirus pisciaire à partir des fermes de saumon atlantique situées dans la région des îles Discovery (Colombie-Britannique)

RÉSUMÉ

(To come)

1	INTRODUCTION
2 3 4 5 6 7	Fisheries and Oceans Canada (DFO) has a regulatory role to ensure the protection of the environment while creating the conditions for the development of an economically, socially and environmentally sustainable aquaculture sector. Within this overall objective, DFO's goal for aquaculture is to ensure that fish and their habitats are protected using avoidance, mitigation, monitoring and compliance approaches that are aligned with the potential risk to the environment.
8 9 10 11	It is recognized that there are interactions between aquaculture operations and the environment (Grant and Jones, 2010; Foreman et al., 2015b). One interaction is the risk to wild salmon populations resulting from the potential spread of infectious diseases from Atlantic Salmon (Salmo salar) farms in British Columbia (BC) (Cohen, 2012a).
12 13 14 15 16	DFO Aquaculture Management Division requested formal science advice on the risk of pathogen transfer from Atlantic Salmon farms to wild fish populations in BC. Given the complexity of interactions between pathogens, hosts and the environment, DFO is delivering the science advice through a series of pathogen-specific risk assessments to be followed by a synthesis.
17 18 19 20 21	This document assesses the risk to Fraser River Sockeye Salmon attributable to piscine orthoreovirus (PRV) from Atlantic Salmon farms in the Discovery Islands area in BC. Risk posed to other wild fish populations and related to other fish farms, pathogens, and regions of BC will be determined through subsequent analyses and are consequently not included in this document.
22	BACKGROUND
23 24 25 26 27 28	This risk assessment is conducted under the DFO Aquaculture Science Environmental Risk Assessment Initiative (hereinafter referred to as the Initiative) implemented as a structured approach to provide science-based risk advice to further support sustainable aquaculture in Canada. Furthermore, to ensure consistency across risk assessments conducted under the Initiative, the Aquaculture Science Environmental Risk Assessment Framework (hereinafter referred to as the Framework) outlines the process and components of each assessment.
29 30 31 32 33 34 35 36 37	The Framework ensures the delivery of systematic, structured, transparent and comprehensive risk assessments. It is consistent with international and national risk assessment frameworks (GESAMP, 2008; ISO, 2009) and has been validated through multiple peer-reviewed processes (Mimeault et al., 2017; Mimeault et al., in review-a; Mimeault et al., in review-b; Mimeault et al., in review-c; Mimeault et al., in review-d). The Framework includes the identification of management protection goals, a problem formulation, a risk assessment and the generation of science advice. The management protection goals and problem formulation were developed in collaboration with DFO's Ecosystems and Oceans Sciences and Ecosystem and Fisheries Management sectors and approved by Aquaculture Management Division.
38 39 40	The Framework also comprises risk communication and a scientific peer-review through DFO's Canadian Science Advisory Secretariat (CSAS) that includes scientific experts both internal and
41	external to DFO. Further details about the Initiative and the Framework are available on the DFO Aquaculture Science Environmental Risk Assessment Initiative webpage.

44 MANAGEMENT PROTECTION GOALS

- 45 In accordance with the recommendations pertaining to aquaculture and fish health in the 2012
- 46 final report of the Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River
- 47 (Cohen, 2012a), the valued ecosystem component in this risk assessment is the Fraser River
- 48 Sockeye Salmon and the management protection goals are to preserve the abundance and
- 49 diversity of the Fraser River Sockeye Salmon.

50 PROBLEM FORMULATION

Hazard identification

- 52 In this risk assessment, the hazard is piscine orthoreovirus (PRV) attributable to Atlantic Salmon
- 53 farms in the Discovery Islands area. Given that PRV1 is the only genogroup detected in North
- 54 America to date (Polinski and Garver, in preparation), is it the genogroup considered in this risk
- assessment. All mentions of PRV in this document refer to PRV1 unless specified otherwise.

Hazard characterisation

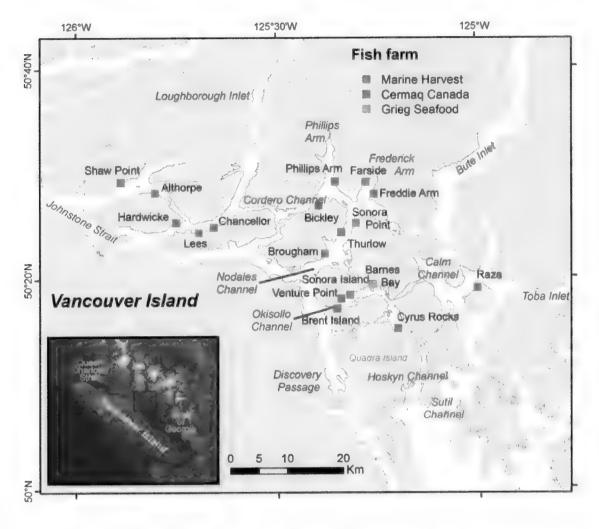
- 57 Polinski and Garver (in preparation) summarized the relevant characteristics of PRV and of
- 58 putatively associated pathologies (e.g., pathogen distribution, virulence, survival in the
- 59 environment, susceptible species, shedding rates in Atlantic Salmon, virulence in Pacific
- 60 salmon) and identified knowledge gaps relevant to this risk assessment.
- 61 Polinski and Garver (in preparation) also included a review of the occurrence of PRV and
- 62 cardiopathies on Atlantic Salmon farms in BC. Additional details specific to Atlantic Salmon
- farms located in the Discovery Islands area are included in this risk assessment.

64 Scope

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- This assessment aims to determine the risk under current farm practices, including regulatory
- 66 requirements and voluntary practices as described in Wade (2017). It focuses on the risk
- 67 attributable to Atlantic Salmon farms in the Discovery Islands area (Salmonid Fish Health Zone
- 68 3-2) and in close proximity (three farms in Zone 3-3 to the northwest of Zone 3-2) (refer to
- 69 Figure 1 and Table 1) and includes the same 18 farms as in Mimeault et al. (2017).
- 70 Although 18 farms are included, it is worth noting that from December 2010 to February 2016,
- 71 the number of stocked Atlantic Salmon farms ranged between 3 and 18, with an average of
- 72 eight farms in any given month (Mimeault et al., 2017).



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Figure 1. Locations of Atlantic Salmon farms in the Discovery Islands area (Zone 3-2 and three farms in Zone 3-3) included in this risk assessment. Symbol size for fish farms is not to scale. Different colours represent different companies operating the farms as identified in the legend. The insert illustrates the location of the Discovery Islands area in BC. Adapted from Mimeault et al. (2017).

77 78

79 Table 1. List of the 18 Atlantic Salmon farms included in the risk assessment.

Company	Farm	Salmonid Fish Health Zone
Cermaq Canada	Brent Island	3-2
•	Raza	3-2
	Venture	3-2
Grieg Seafood	Barnes	3-2
Marine Harvest Canada	Althorpe	3-3
	Bickley	3-2
	Brougham	3-2
	Chancellor	3-2
	Cyrus Rocks	3-2
	Farside	3-2
	Freddie Arm	3-2
	Hardwicke	3-3
	Lees	3-2
	Phillips Arm	3-2
	Shaw Point	3-3
	Sonora Point	3-2
	Sonora/Okisollo	3-2
	Thurlow	3-2

- 80 This risk assessment focuses on the potential direct impacts of PRV attributable to Atlantic
- 81 Salmon farms in the Discovery Islands area on Fraser River Sockeye Salmon abundance and
- 82 diversity. Potential indirect impacts to Fraser River Sockeye Salmon through complex
- 83 ecosystem processes resulting from infection of other susceptible Pacific salmon species are
- 84 not considered.

Risk guestion

- 86 What is the risk to Fraser River Sockeye Salmon abundance and diversity due to the transfer of
- 87 PRV from Atlantic Salmon farms located in the Discovery Islands area under current farm
- 88 practices?

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Methodology

- 90 The methodology is based on Mimeault et al. (2017) which was adapted from the DFO
- 91 Guidelines for Assessing the Biological Risk of Aquatic Invasive Species in Canada (Mandrak et
- 92 al., 2012), the World Organization for Animal Health (OIE) Import Risk Analysis (OIE, 2010),
- 93 recommendations for risk assessments in coastal aquaculture (GESAMP, 2008) and the Food
- 94 and Agriculture Organization guidelines on understanding and applying risk analysis in
- 95 aquaculture (FAO, 2008).

Conceptual model

- 97 The conceptual model (Figure 2) is adapted from Mimeault et al. (2017) in which the likelihood
- 98 of an event to take place and its potential magnitude of consequences are combined into a
- 99 predefined risk matrix to estimate the risk. The likelihood is assessed in four consecutive steps
- namely: a farm infection assessment; a release assessment; an exposure assessment; and an
- infection assessment. The consequence assessment determines the potential magnitude of

impacts of PRV infection attributable to Atlantic Salmon farms in the Discovery Islands area on the abundance and diversity of Fraser River Sockeye Salmon.

LIKELIHOOD ASSESSMENT Farm infection assessment Likelihood that farmed Atlantic Salmon infected with PRV are present on one or more farms in the Discovery Islands area in a given year Release assessment Likelihood that any PRV would be released from an Atlantic Salmon farm located in the Discovery Islands area Exposure assessment Likelihood that at least one susceptible wild fish would be exposed to PRV released from Atlantic Salmon farm(s) Infection assessment RISK ESTIMATION Likelihood that at least one susceptible wild fish exposed to PRV would become infected LIKELIHOOD CONSEQUENCES CONSEQUENCE ASSESSMENT Magnitude of impacts to the diversity Magnitude of impacts to the abundance of Fraser River Sockeye Salmon of Fraser River Sockeye Salmon

Figure 2. Conceptual model to assess the risks to Fraser River Sockeye Salmon resulting from piscine orthoreovirus attributable to Atlantic Salmon farms located in the Discovery Islands area, BC. Adapted from Mimeault et al. (2017).

108 Terminology

The categories and definitions used to rank likelihood (Table 2), consequences to abundance (Table 3), consequences to diversity (Table 4), uncertainty for data and information (Table 5) and uncertainty for fish health management (Table 6) were adapted from Mimeault et al. (2017).

Table 2. Categories and definitions used to describe the likelihood of an event over a period of a year. "Extremely unlikely" is the lowest likelihood and "extremely likely" is the highest likelihood. Adapted from Mimeault et al. (2017).

Categories	Definitions	
Extremely unlikely	Event has little to no chance to occur	
Very unlikely	Event could occur rarely	
Unlikely	Event could occur occasionally	
Likely	Event will usually occur	
Very likely	Event will occur in most instances	
Extremely likely	Event will occur/is expected to occur	

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113 114 116 Table 3. Categories and definitions used to describe the potential consequences to the abundance of 117 Fraser River Sockeye Salmon. Adapted from Mimeault et al. (2017).

Categories	Definitions
Negligible	0 to 1% reduction in the number of returning Fraser River Sockeye Salmon
Minor	> 1 to 5% reduction in the number of returning Fraser River Sockeye Salmon
Moderate	> 5 to 10% reduction in the number of returning Fraser River Sockeye Salmon
Major	> 10 to 25% reduction in the number of returning Fraser River Sockeye Salmon
Severe	> 25 to 50% reduction in the number of returning Fraser River Sockeye Salmon
Extreme	> 50% reduction in the number of returning Fraser River Sockeye Salmon

Table 4. Categories and definitions used to describe the potential consequences to the diversity of Fraser
 River Sockeye Salmon.CU: Conservation Unit. Adapted from Mimeault et al. (2017).

Categories	Definitions
Negligible	0 to 1% change in abundance over a generation and no loss of Fraser River Sockeye Salmon CUs over a generation
Minor	> 1 to 10% reduction in abundance in some CUs that would not result in the loss of a Fraser River Sockeye Salmon CU over a generation
Moderate	 > 1 to 10% reduction in abundance in most conservation units that would not result in the loss of a Fraser River Sockeye Salmon CU over a generation; OR > 10 to 25% reduction in abundance in one or more CUs that would not result in the loss of a Fraser River Sockeye Salmon CU over a generation
Major	> 25% reduction in abundance in one or more CUs that would not result in the loss of a Fraser River Sockeye Salmon CU over a generation
Severe	Reduction in abundance that would result in the loss of a Fraser River Sockeye Salmon CU over a generation
Extreme	Reduction in abundance that would result in the loss of more than one Fraser River Sockeye Salmon CU over a generation

Table 5. Categories and definitions used to describe the level of uncertainty associated with data and information. Taken from Mimeault et al. (2017).

Categories	Definitions
High uncertainty	 No or insufficient data Available data are of poor quality Very high intrinsic variability Experts' conclusions vary considerably
Reasonable uncertainty	 Limited, incomplete, or only surrogate data are available Available data can only be reported with significant caveats Significant intrinsic variability Experts and/or models come to different conclusions
Reasonable certainty	 Available data are abundant, but not comprehensive Available data are robust Low intrinsic variability Experts and/or models mostly agree
High certainty	 Available data are abundant and comprehensive Available data are robust, peer-reviewed and published Very low intrinsic variability Experts and/or models agree

Table 6. Categories and definitions used to describe the level of uncertainty associated with fish health management. "Some" and "most" are respectively defined as less and more than 50% of relevant data.

Taken from Mimeault et al. (2017).

Categories	Definitions
High uncertainty	 No information collected through farm management practices, as specified in Salmonid Health Management Plans, is available Discrepancy between information/data obtained through farms and farm audits for all farms Voluntary farm practice(s) Expert opinion varies considerably
Reasonable uncertainty	 Some information collected through farm management practices, as specified in Salmonid Health Management Plans, is available Discrepancy between information/data obtained through farms and farm audits for most farms Voluntary company practice(s) Experts come to different conclusions
Reasonable certainty	 Most information collected through farm management practices, as specified in Salmonid Health Management Plans, is available Corroboration between information/data obtained through farms and farm audits for most farms Voluntary industry-wide practice(s) agreed through a Memorandum of Understanding or certification by a recognized third party Experts mostly agree
High certainty	 All information collected through farm management practices, as specified in Salmonid Health Management Plans, is available Corroboration between information/data obtained through farms and farm audits for all farms Mandatory practice(s) required under legislation and certification by a recognized third party Experts agree

Combination rules

As described in Mimeault et al. (2017), the combination of likelihoods differs if events are dependent or independent: "An event is dependent when its outcome is affected by another event. For example, infection can only happen if exposure took place, consequently infection is dependent on exposure. Events are independent when the outcome of one event does not affect the outcome of other event(s); for example, a pathogen can be released into the environment via different unrelated pathways". Likelihoods are combined as per accepted methodologies in qualitative risk assessments adopting the lowest value (e.g., low) for dependent events and the highest value (e.g., high) for independent events (Cox, 2008; Gale et al., 2010; Cudmore et al., 2012).

Uncertainties are reported at each step of the risk assessment. Several approaches have been used for combining qualitative uncertainty rankings in risk assessments. Some authors report uncertainty for every step without combination (Peeler and Thrush, 2009; Jones et al., 2015), others adopt the highest uncertainty (Mandrak et al., 2012) while finally others adopt the highest uncertainty associated with the lowest likelihood for dependent events (Cudmore et al., 2012). In this risk assessment, uncertainties are not combined in the overall likelihood and

141 consequence assessments to keep the emphasis on the uncertainty associated to each step.

142 **Risk estimation**

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As described in Mimeault et al. (2017), two risk matrices were developed in collaboration with 143

DFO's Ecosystems and Oceans Sciences and Ecosystem and Fisheries Management sectors 144

to categorize the risk estimates for the abundance (Figure 3) and diversity (Figure 4) of Fraser 145

River Sockeye Salmon. They are aligned with relevant scale of consequences for fisheries 146

management and policy purposes, existing policy and current management risk tolerance

relevant to the risk assessments. 148

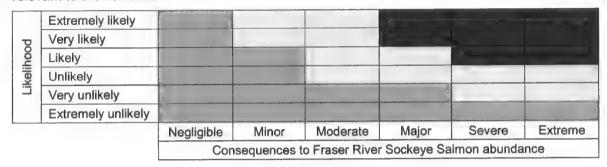
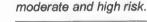


Figure 3. Risk matrix for combining the results of the assessment of the likelihood and consequences to 149 Fraser River Sockeye Salmon abundance. Green, yellow and red, respectively, represent minimal, 150 151



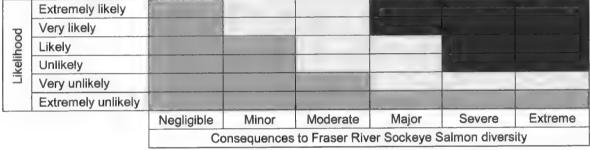


Figure 4. Risk matrix for combining the results of the assessment of the likelihood and consequences to Fraser River Sockeye Salmon diversity. Green, yellow and red, respectively, represent minimal, moderate and high risk.

LIKELIHOOD ASSESSMENT

The likelihood assessment consists of determining the likelihood that Fraser River Sockeye 156 Salmon would become infected with piscine orthoreovirus (PRV) attributable to Atlantic Salmon 157 farms located in the Discovery Islands area. 158

Each step of the likelihood assessment assumes that current management practices on Atlantic 159 Salmon farms are followed and will be maintained. 160

FARM INFECTION ASSESSMENT

Question

In a given year, what is the likelihood that farmed Atlantic Salmon infected with PRV are present on one or more farms in the Discovery Islands area?

165 Considerations

- 166 Considerations include evidence of Atlantic Salmon susceptibility to PRV; regulatory
- requirements; industry practices; PRV prevalence in hatcheries; and evidence of PRV on
- 168 Atlantic Salmon farms in the Discovery Islands area.

169 Atlantic Salmon susceptibility to PRV infection

- 170 PRV genetic material has been detected in Atlantic Salmon in several countries (Palacios et al.,
- 171 2010; Kibenge et al., 2013; Marty et al., 2015; Adamek et al., 2018; Gunnarsdóttir et al., 2018;
- 172 Markussen et al., 2018; Warheit, 2018).
- 173 More specifically, Atlantic Salmon infection with the PRV genetic type from Pacific Canada has
- been demonstrated through a cohabitation study (Garver et al., 2016a) and PRV has been
- 175 reported on Atlantic Salmon farms in BC (Marty et al., 2015; Di Cicco et al., 2017; Nekouei et
- 176 al., 2018; Laurin et al., 2019) supporting Atlantic Salmon susceptibility to PRV.

Regulatory requirements

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Licensing and biosecurity

- 179 DFO has had the primary responsibility for the regulation and management of aquaculture in BC
- 180 since December 2010 through the Pacific Aquaculture Regulations (PAR) developed under the
- 181 Fisheries Act. DFO is therefore responsible for issuing aquaculture licenses for marine finfish,
- 182 shellfish and freshwater operations in BC.
- 183 Each farm operating in BC requires a Finfish Aquaculture Licence under the PAR which
- 184 includes the requirement for a Salmonid Health Management Plan (SHMP) and accompanying
- proprietary Standard Operating Procedures (SOPs) (DFO, 2015). The SHMP outlines the health
- 186 concepts and required elements associated with a finfish aquaculture licence, while
- 187 accompanying SOPs detail the procedures to address specific concepts of the SHMP including
- monitoring fish health and diseases (DFO, 2015; Wade, 2017).
- 189 The SHMP includes requirements related to "Keeping Pathogens Out" (section 2.5 of the
- 190 SHMP) (DFO, 2015) including that particular care be taken to avoid undue fish stress and
- 191 transmission of pathogens and also requires a licence by the Introductions and Transfer
- 192 Committee in advance of any fish transfers (DFO, 2015).

Fish Health Audit and Surveillance Program

- 194 Samples from recently dead fish are collected through the Fish Health Audit and Surveillance
- 195 Program (audit program) to audit the routine monitoring and reporting of diseases by the farms
- 196 (Wade, 2017). Moribund fish can also be sampled (I. Keith, DFO, 103-2435 Mansfield Drive,
- 197 Courtenay, BC V9N 2M2, pers. comm., 2018). DFO aims to audit 30 randomly selected farms
- 198 per quarter or 120 farms per year (Wade, 2017).
- 199 During an audit, a maximum of 30 fresh fish are selected for histopathology, bacteriology and
- 200 molecular diagnostics/virology, although in most circumstances eight fresh fish are sampled
- 201 (Wade, 2017). PRV is not included in the molecular diagnostics completed on audit samples.

Introduction and Transfer Committee

- 203 DFO grants Introduction and Transfer licenses under Section 56 of the Fishery (General)
- 204 Regulations. The Introductions and Transfers Committee (ITC) assesses the health, genetic and
- 205 ecological impacts that could occur through the transfer of fish into and within the Province. A
- 206 Section 56 introductions and transfers licence is required for all movements of salmon between
- 207 licensed aquaculture facilities (DFO, 2018b). For the aquaculture industry, the committee

- 208 assesses the health of fish to be transferred which includes the diseases and causative agents
- of regional, national or international concern as listed in Appendix III1 of the Marine Finfish
- 210 Aquaculture Licence under the Fisheries Act, along with any other concern that may arise
- 211 during the assessment.
- 212 For every aquaculture related transfer application, fish health reports and husbandry records are
- 213 examined by Aquaculture Management Division staff prior to transfer. If any clinical signs of
- 214 diseases are seen, or there are any other concerns, the committee can either recommend that
- 215 the transfer should not happen, or they can work with the applicant to ensure the transfer is
- 216 carried out in a safe manner. Currently, there are no requirements to test for PRV prior to the
- 217 transfer of fish into marine net pens or between sites (M. Higgins, Fisheries and Oceans
- 218 Canada, pers. comm., 2018).

Industry practices

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- 220 Companies rearing Atlantic Salmon on marine sites in the Discovery Islands area are Cermaq
- 221 Canada, Grieg Seafood and Marine Harvest Canada.

Movement of live fish

- 223 Between January 2013 and December 2017, Atlantic Salmon have been present on farms in the
- 224 Discovery Islands area throughout the year (Appendix A, Figure 6). The duration of farmed
- 225 Atlantic Salmon production cycles in the Discovery Islands area over the same period ranged
- between 12 and 23 months (average=17 months, n=27 cycles) from the beginning of stocking to
- 227 the end of harvesting periods.
- 228 In the Discovery Islands area, smolts are not transferred directly from freshwater hatcheries to
- 229 marine sites due to the risk of infection from *Kudoa* sp., a parasite of marine fishes (Wade,
- 230 2017) with the exception of Raza where Kudoa sp. has not been an issue (
- 231 Cermaq Canada, 203-919 Island Highway, Campbell River, BC, Canada V9W 2C2, pers.
- 232 comm., 2018).
- 233 Fish transfers to marine grow-out sites in the Discovery Islands area occurred every months of
- 234 the year, with most of them in May and June (Appendix A, Figure 7). Fish reared in this area
- can previously spend between 2 to 14 months (average=7 months, n=23 cycles) on a marine
- 236 nursery site before being transferred to a grow-out site.

237 Surveillance and testing

Every stocked marine production site is monitored daily by on-site trained staff for syndromic surveillance during which mortalities are removed and classified. Staff alerts the veterinarian if there are any concerns. Additionally, routine health checks are conducted regularly by all companies during which fresh mortalities and/or silvers are examined for signs of diseases or abnormal conditions and sampled for pathogen screening on an as needed basis based on syndromic surveillance, site history, environmental conditions and professional judgement of the

¹ In 2018, diseases of regional, national or international concern listed in the Marine Finfish Aquaculture Licence under the Fisheries Act are Infectious Hematopoietic Necrosis (IHN) and infectious hematopoietic necrosis virus; Infectious Pancreatic Necrosis (IPN) and infectious pancreatic necrosis virus; Viral Hemorrhagic Septicemia (VHS) and viral hemorrhagic septicemia virus; Infectious Salmon Anemia (ISA) and infectious salmon anemia virus; Oncorhynchus masou Virus Disease (OMV) and Oncorhynchus masou virus; Whirling Disease and Myxobolus cerebralis; Cold Water Vibriosis and Vibrio salmonicida; and any other filterable replicating agent causing cytopathic effects in cell lines specified by the Minister or is causative of identifiable clinical disease in fish.

244 245	pathogen screening varies among companies as described below.
246 247 248 249 250	In addition to daily monitoring, every Cermaq Canada stocked marine production site is visited by fish health staff or the veterinarian a minimum of once every two weeks to confirm on-site mortality classification and to sample up to five moribund or fresh mortalities with no obvious cause of death (e.g., non-performing, algae, handling, low oxygen, matures, deformities) Cermaq Canada, pers. comm., 2018).
251 252 253 254	In addition to daily monitoring, every Grieg Seafood stocked marine production site is visited at least once every quarter by the fish health staff and/or veterinarian where at least five silvers are sampled for bacteriology, histology and PCR testing Grieg Seafood, pers. comm., 2018).
255 256 257 258 259 260	In addition to daily monitoring, every Marine Harvest Canada stocked production site is visited at least once a month by fish health staff or the veterinarian and at least once every quarter by the veterinarian. Fresh mortalities and/or silver samples may be collected for pathogen screening based on syndromic surveillance, site history, environmental conditions and professional judgement of the veterinarian and the fish health team Marine Harvest Canada, pers. comm., 2018).
261	Vaccination and treatment
262 263 264	There is no commercial vaccine available for PRV nor are there treatments available for PRV-infected Atlantic Salmon. There is no data to suggest that PRV adversely affects aquaculture production of salmon in BC (Polinski and Garver, <i>in preparation</i>).
265	PRV prevalence in Atlantic Salmon hatcheries
266 267 268 269	Industry conducts sampling for PRV screening including prior to fish transfers to marine sites. Table 7 presents last PRV screening results of Atlantic Salmon sampled in BC hatcheries prior to transfer to a marine site, either directly or indirectly into the Discovery Islands area. This represents a proportion of the overall hatchery PRV screening that the industry conducts.
270 271 272 273	Between 2013 and 2018, PRV has been detected in hatcheries in all years, with percent PRV positive sampled fish ranging between 0.2 to 72.5%. The trends observed show an increase in the number of samples collected during this period and a decrease in the percentage of PRV positive sampled fish.

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Table 7. PRV screening conducted between 2013 and 2018 in Atlantic Salmon in hatcheries prior to direct or indirect transfer to marine sites in the Discovery Islands area, BC. Results only include last sampling events prior to transfer. Source: Data provided by the industry in January 2019.

Year	Number of fish screened for PRV *	Number of PRV positive fish	Percent PRV positive fish
2013	48	20	41.7
2014	40	29	72.5
2015	110	29	26.4
2016	189	21	11.1
2017	370	3	0.8
2018	584	1	0.2

^{*} Three sampling events (two in 2015 and one in 2016), out of a total of 42, had unspecified number of fish for which
25 fish per sampling event were assumed

PRV prevalence on Atlantic Salmon farms in BC

Several studies have reported PRV on Atlantic Salmon farms in BC (Marty et al., 2015; Di Cicco et al., 2017; Laurin et al., 2019).

Marty et al. 2015 reported 95% (35/37) of archived samples of farmed Atlantic Salmon collected between 2000 and 2008 from DFO management areas 7, 12,13 and 18 (respectively Prince and Hunter Islands; Northern Johnstone Strait; Quadra and Cortes Islands; and Mayne Island, Saanich) and 100% (20/20) of Atlantic Salmon sampled in 2013 from a marine rearing site in the Northern Johnstone Strait approximately one month after transfer from a hatchery, to be PRV positive.

Di Cicco et al. (2017) reported 19% (8/42) of Atlantic Salmon sampled on a farm in BC in 2013 about three to four months after seawater transfer and 100% (43/43) of those sampled after five to six months in seawater, to be PRV positive.

Laurin et al. (2019) reported 67% (448/668) of all recently dead and moribund Atlantic Salmon sampled through the audit program between April 2011 and December 2013 on farms across BC to be PRV positive; a proportion that varied approximately from 40% to nearly 90% among different fish health zones in BC. Time-at-sea was a significant predictor for PRV detection in Atlantic Salmon with the highest odds of detecting the virus reported 12 to 18 months after transfer to seawater (Laurin et al., 2019).

In on-going research examining PRV prevalence on thirteen Atlantic Salmon farms in BC, including in the Discovery Islands area, all sites became PRV positive with a general onset between approximately 100 to 200 days after seawater entry and 100% of samples (132/132) collected from fish at sea for more than 296 days were PRV positive (Polinski and Garver, unpublished data reported in Polinski and Garver (*in preparation*)).

Although the above studies are not limited to Atlantic Salmon farms in the Discovery Islands area and the average proportion of PRV positive recently dead and moribund farmed Atlantic Salmon was reported to vary among fish health zones (Laurin et al., 2019), overall PRV is ubiquitous, highly prevalent and persistent on Atlantic Salmon farms in BC.

306 PRV screening results provided by the industry to support this risk assessment also indicate that most fish become infected with the virus at some point in the marine grow-out phase.

308 Assumptions

- Positive detection of the pathogen is evidence of infection; and
- Results from research studies throughout all zones are representative of the Discovery Islands area.

Likelihood of farm infection

- Table 8 presents the main factors contributing to and limiting the likelihood of a PRV infection occurring on an Atlantic Salmon farm in the Discovery Islands area. Those factors were used to determine the likelihood and uncertainty rankings based on definitions in tables 2, 5 and 6.
- Table 8. Factors contributing to and limiting piscine orthoreovirus infection pressure from Atlantic salmon farms in the Discovery Islands area under the current farm practices.

Contributing factors		Limiting factors	
•	 Atlantic Salmon are susceptible to PRV; All Atlantic Salmon farms in the Discovery Islands area are anticipated to become infected with PRV within 100-200 days post- seawater transfer; 		Hatchery-origin infection is mitigated through egg disinfection, a requirement of the SHMP and other biosecurity practices.
•			
•	Independent of farm location or season of transfer to seawater, Atlantic Salmon farms become infected with PRV and can reach 100%;		
•	In the Discovery Islands area, except for one site, smolts are transferred from other marine rearing sites;		
•	Smolts may be held from 2 to 14 months in marine nursery sites before transfer to Discovery Islands area; and		
•	Current regulatory requirements for an aquaculture-related BC introduction and transfers licence are related to clinical signs of disease and/or the detection of the causative agents listed in Appendix III of the Marine Finfish Aquaculture Licence under the Fisheries Act which does not include PRV.		

It was concluded that, in a given year, the likelihood that farmed Atlantic Salmon infected with PRV are present on one or more Atlantic Salmon farms in the Discovery Islands area is **extremely likely** under the current farm practices given the evidence of PRV infection on Atlantic Salmon farms following seawater transfer. This conclusion was made with **high certainty** given abundant and robust data demonstrating PRV infections on Atlantic Salmon farms in BC.

324 RELEASE ASSESSMENT

325 Question

- 326 Assuming that Atlantic Salmon infected with PRV are present, what is the likelihood that any
- 327 PRV would be released from an Atlantic Salmon farm located in the Discovery Islands area into
- 328 an environment accessible to wild fish populations?

329 Considerations

- 330 Considerations include Atlantic Salmon rearing conditions in the Discovery Islands area;
- 331 shedding of PRV from infected fish; and fish health management practices.

332 Atlantic Salmon rearing methods

- 333 Atlantic Salmon reared on marine sites in the Discovery Islands area are contained in net pens.
- Under such conditions, water flows freely through the cages and there are no barriers to
- pathogen exchanges between the net pens and the environment (Johansen et al., 2011).

336 Shedding of PRV from infected fish

- 337 Polinski and Garver (in preparation) reviewed the state of knowledge related to shedding in
- 338 PRV-infected fish. Given evidence of horizontal transmission during cohabitation study (Garver
- et al., 2016a), PRV infected salmon are considered to be a source of the virus (Polinski and
- 340 Garver, in preparation). PRV has been detected in faecal contents of Atlantic Salmon
- 341 challenged through injections or anal intubation with a PRV inoculum originating from
- Norwegian field heart and skeletal muscle inflammation (HSMI) outbreak (Hauge et al., 2016).
- 343 The above studies provide evidence that PRV-infected fish can shed the virus into the
- 344 surrounding environment.
- 345 To this date, the rate of shedding from PRV-infected Atlantic Salmon (or other salmonids) has
- not been quantified (Polinski and Garver, in preparation). However, based on cohabitation
- 347 studies (Garver et al., 2016a; Polinski et al., in press), it is hypothesized that horizontal
- 348 transmission primarily occurs between 3 to 15 weeks following infection, after which the
- potential for natural shedding becomes severely reduced despite persistence of infection
- 350 (Polinski and Garver, in preparation).

Fish health management practices

- 352 All licence holders must comply with the Health Management Plan which includes biosecurity
- 353 measures to maintain fish health, prevent pathogen entry and limit the spread of diseases on
- 354 farm (DFO, 2015).

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- 355 The Salmonid Health Management Plan (SHMP) requires procedures for collecting,
- categorizing, recording, storing and disposing of fish carcasses (DFO, 2015). More specifically,
- procedures must be in place for the regular removal of carcasses to storage containers; the
- 358 reporting of mortality by category to DFO; a secure location of stored carcasses until transfer to
- 359 land-based facilities; to prevent contents from leaking into the receiving waters; the secure
- 360 transfer of stored carcasses to land-based facilities; and sanitization methods for storage
- 361 containers, equipment and other handling facilities or vessels (DFO, 2015). The SHMP also
- 362 requires a SOP for fish disease outbreaks or emergency, where an outbreak is defined as an
- 363 "unexpected occurrence of mortality or disease" (DFO, 2015).
- 364 Beyond indicating if a SOP is required, DFO does not prescribe how elements of the SHMP
- should be achieved. It is therefore up to the company to address the concepts to the satisfaction

- of the DFO's fish health veterinarian (Wade, 2017). Consequently, it is assumed that for companies with a valid finfish aquaculture licence, the SOPs submitted are in compliance with the conditions of licence and approved by the DFO veterinarian (Wade, 2017).
- Protocols are in place for handling and storing dead fish; for labeling, cleaning, disinfecting and storing gear used to handle dead fish; to restrict visitors who must obtain permission prior to arriving on site; to control on-site visitors through the use of signage, footbaths and site specific protective clothing; net washing procedures, not sharing equipment when possible, cleaning and disinfecting equipment after use and dry storing in proper locations; for cleaning, disinfecting and transferring large and submerged equipment among sites; and biosecurity measures to control vessel movement (Wade, 2017).
- Compliance with the above elements is determined through the audit program. On average, less than one deficiency has been reported per audit on Atlantic Salmon farms in BC between 2011 and 2017 (Appendix B, Table 15). Most deficiencies reported in this period were related to sea lice protocols and sea lice records; carcass retrieval protocol or record keeping that requires improvement; mooring signage needing improvement; and transfer records not being complete.

Assumptions

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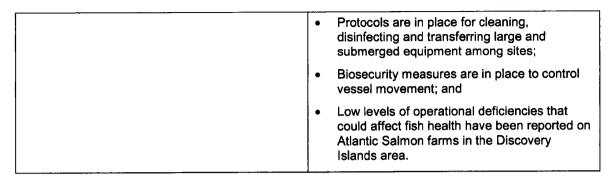
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- Atlantic Salmon infected with PRV are present on at least one farm; and
- Biocontainment measures are effective against PRV (e.g., Virkon footbaths, etc.).

Likelihood of release

- Table 9 presents the main factors contributing to and limiting the likelihood that PRV would be released from an infected Atlantic Salmon farm in the Discovery Islands area. These factors were used to determine the likelihood and uncertainty rankings based on definitions in Tables 2, 5 and 6.
- Table 9. Factors contributing to and limiting the likelihood that piscine orthoreovirus will be released from infected and/or diseased Atlantic Salmon on farms in the Discovery Islands area under the current farm practices.

Contributing factors	Limiting factors	
 PRV-infected Atlantic Salmon can shed the virus into the surrounding environment; and Atlantic Salmon in the Discovery Islands area are reared in net pens allowing pathogens, including PRV, to be released from the farms to the surrounding environment. 	 Protocols are in place for handling and storing dead fish; for labeling, cleaning, disinfecting and storing gear used to handle dead fish; Protocols are in place to restrict visitors who must obtain permission prior to arriving on site and to control on-site visitors through the use of signage, footbaths and site specific protective clothing; Protocols are in place to minimize predators and wildlife access; Protocols are in place for net washing procedures, not sharing equipment when possible, cleaning and disinfecting equipment after use and dry storing in proper locations; 	



Two pathways were considered in the release assessment: (1) infected farmed Atlantic Salmon and (2) mechanical vectors and fomites.

Release through infected farmed Atlantic Salmon

It was concluded that the likelihood that PRV would be released from an Atlantic Salmon farm located in the Discovery Islands area into an environment accessible to Fraser River Sockeye Salmon through infected farmed Atlantic Salmon is **extremely likely** under the current farm practices given rearing of Atlantic Salmon in net pens and evidence that infected Atlantic Salmon can shed the virus. This conclusion was made with **high certainty** based on robust published laboratory studies on horizontal transfer and infection through cohabitation studies.

Release through vectors and fomites

It was concluded that the likelihood that PRV would be released from an Atlantic Salmon farm located in the Discovery Islands area into an environment accessible to wild fish populations through vectors or fomites is **unlikely** under the current farm practices. This conclusion was made with **reasonable uncertainty** given relevant biosecurity practices are part of licence requirements and low levels of operational deficiencies that could affect fish health on Atlantic Salmon farms in the Discovery Islands area but also given the use of proxy data and assumption that biocontainment practices are effective against PRV.

Overall likelihood of release

The overall likelihood of release was obtained by adopting the highest likelihood of the release pathways. It is therefore **extremely likely** that PRV would be released from an Atlantic Salmon farm should it become infected.

EXPOSURE ASSESSMENT

Question

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- Assuming that PRV has been released from at least one Atlantic Salmon farm in the Discovery Islands area, what is the likelihood that at least one Fraser River Sockeye Salmon would be
- 417 exposed to PRV in a given year?

Considerations

- The exposure assessment consists of determining the spatial and temporal concurrence of the released pathogen and susceptible species (Taranger et al., 2014).
- 421 Considerations include size and volume of Atlantic Salmon farms; occurrence of Fraser River
- Sockeye Salmon in the Discovery Islands area; timing of PRV on Atlantic Salmon farms;

survival of PRV in the marine environment; and concurrence of PRV and Fraser River Sockeye Salmon.

Size and volume of Atlantic Salmon farms

The likelihood of Fraser River Sockeye Salmon to encounter Atlantic Salmon farms on their migration routes should take into account the relative size and volume of farms in the area and within channels.

Atlantic Salmon farms in the Discovery Islands area occupy an extremely small area (0.007%) and volume (0.0008%) of the overall region (Mimeault et al., 2017). Additionally, considering that channel width in the Discovery Islands area varies between approximately 850 and 3,200 meters (Mimeault et al., 2017), a farm with dimension of 100 m by 100 m by 20 m depth would span over approximately 3 to 12% of the width of the channel (Figure 5).

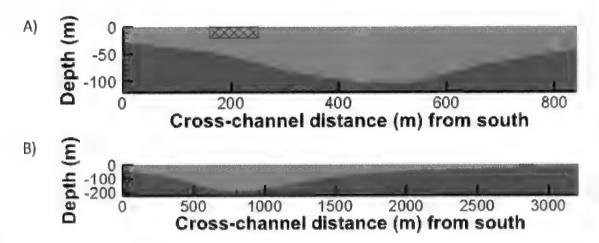


Figure 5. Cross sections of channels at (A) Brent and (B) Shaw farms located in respectively the narrowest and widest channel with Atlantic Salmon farms in the Discovery Islands area. Cross-hatched boxes show the cross-channel projection of the net-pens of the farms depicted at scale, i.e., what fish swimming along-channel would encounter. Note the difference in the ranges on the axes to maintain constant ratio (one:one) between the x and y axes in each cross section. Adapted from Mimeault et al. (2017).

Fraser River Sockeye Salmon in Discovery Islands area

Out-migrating juveniles

Juvenile Fraser River Sockeye Salmon migrate through the Discovery Islands area every year from mid-May to mid-July (reviewed in Grant et al., 2018). The total number of juveniles out-migrating from the Fraser River is unknown (Grant et al., 2018). The only estimate of abundance is limited to stocks from Chilko Lake (Grant et al., 2018) based on smolts enumerated at a counting fence located at the outlet of the lake. Between 1953 and 2007, annual estimates ranged between 1.6 to 77 million (average: 20 million) (Grant et al., 2018).

- 449 Knowledge of juvenile marine out-migration routes through the Discovery Islands area is limited,
- 450 however, based on 2016 and 2017 telemetry-based results, 37 to 73% (average of 55%²) of
- 451 Chilko Lake Sockeye Salmon migrated east of Quadra Island (Rechisky et al., 2018).

452 Returning adults

- 453 Sockeye Salmon return to the Fraser River either through the northern route (Johnstone Strait)
- or the southern route (Strait of Juan de Fuca) (reviewed in Grant et al., 2018). Between 1980
- and 2014, the total adult returns of Fraser River Sockeye Salmon ranged from 2 to 28 million,
- 456 with an annual average of 9.6 million (Grant et al., 2018).
- 457 The proportion of Sockeye Salmon that migrate through the northern route, referred to as the
- 458 northern diversion rate, is highly variable. Based on data provided by the Pacific Salmon
- Commission, the northern diversion rate between 1980 and 2015 ranged between 10% in 2008
- and 96% in 2014 (average of 52%). Returning adult Fraser River Sockeye Salmon migrate
- 461 through the Discovery Islands area from late-June to early-October (reviewed in Grant et al.,
- 462 2018).

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Timing of PRV on Atlantic Salmon farms

- PRV has been reported on Atlantic Salmon farms in BC (Marty et al., 2015; Di Cicco et al.,
- 2017; Laurin et al., 2019). Refer to Farm Infection Assessment section for more details on
- 466 prevalence. Of relevance to the exposure assessment is the timing of PRV detections on
- 467 Atlantic Salmon farms in the Discovery Islands area.
- 468 PRV was detected in Atlantic Salmon sampled in the month of April 2013 on a marine rearing
- site in BC (Marty et al., 2015); in the months of August through November 2013 and January
- 470 2014 on a marine rearing site in BC (Di Cicco et al., 2017); and between April 2011 and
- 471 December 2013 through the DFO Regulatory Fish Health Audit Program on marine sites in BC,
- including in the Discovery Islands area (Laurin et al., 2019). Finally, on-going investigations
- 473 examining PRV prevalence on thirteen Atlantic Salmon farms in BC detected PRV infections on
- 474 Atlantic Salmon farms in the Discovery Islands area throughout the year.
- 475 Given that fish are transferred to marine rearing sites in the Discovery Islands area throughout
- 476 the year (Appendix A, Figure 7), sites in this area could theoretically become positive throughout
- 477 the year. While the sample sizes used are small, the results have been consistent throughout
- 478 farms sampled in BC.
- 479 Overall, PRV has been reported on at least one Atlantic Salmon farm in the Discovery Islands
- 480 area in all months of the year.

PRV survival in the marine environment

- 482 No studies have been conducted on the survival of PRV in the environment and suitable
- 483 surrogate data are not available (Polinski and Garver, in preparation). However, given that
- waterborne transmission of PRV has been demonstrated in seawater (Garver et al., 2016a;
- Polinski et al., in press), and PRV being free of an envelope, it can be presumed that it
- 486 maintains a minimum capacity to survive in water even if the duration of survival and infectivity
- 487 in seawater are unknown (Polinski and Garver, in preparation).

² Average of tagged fish reported to migrate east of Quadra Islands (37% of age-1 Chilko Lake Sockeye Salmon in 2016, 73% of age-1 Chilko Lake Sockeye Salmon in 2017 and 54% of age-2 Chilko Lake Sockeye Salmon) (Rechisky et al., 2018).

Concurrence between Fraser River Sockeye Salmon and PRV

Spatial

Given evidence of juvenile and adult Fraser River Sockeye Salmon migration through the Discovery Islands area and evidence of PRV on at least one Atlantic Salmon farm in the Discovery Islands area, it was concluded that there is potential spatial concurrence between Fraser River Sockeye Salmon and PRV attributable to Atlantic Salmon farms in the Discovery Islands area.

Temporal

Table 10 summarizes evidence of temporal overlap between Fraser River Sockeye Salmon and PRV on Atlantic Salmon farms in the Discovery Islands area. Given that (1) Fraser River Sockeye Salmon are present in the Discovery Islands area between May and October; (2) Atlantic Salmon farms in the Discovery Islands area are stocked throughout the year; and (3) PRV has been reported throughout the year on Atlantic Salmon farms in the Discovery Island area, it was concluded that there is temporal concurrence between Fraser River Sockeye Salmon and PRV attributable to Atlantic Salmon farms in the Discovery Islands area.

Table 10. Summary of evidence of temporal overlap between Fraser River Sockeye Salmon and piscine orthoreovirus on Atlantic Salmon farms in the Discovery Islands area. The "X" indicates evidence of presence of Fraser River Sockeye Salmon in a given month; letters on the first row of the table represent months of the year from January to December. Data source: Marty et al. (2015); Di Cicco et al. (2017); Grant et al. (2018); Laurin et al. (2019) and unpublished data reported in Polinski and Garver (in preparation).

Fraser River Sockeye Salmon in the Discovery Islands area	J	F	M	A	N	J		A	\$	0	N	D
Lake-type juvenile					x	×	x					
Returning adult						х	х	х	х	х		
Farmed Atlantic Salmon in the Discovery Islands area	ű		N	A	W	J	j		3	0	Ň	D
Stocked net pens	x	х	х	x	x	x	×	х	x	x	x	×
Stocking events	х	х	Х	х	×	х	х	х	х	х	х	Х
PRV positive detections	х	х	х	x	×	х	х	х	х	х	х	х

Assumptions

- At least one Fraser River Sockeye Salmon has been exposed to PRV released from Atlantic
 Salmon farms in the Discovery Islands area;
- Positive detections of PRV is evidence that the pathogen is present in sampled fish;
- PRV-infected fish are shedding the virus;
- Shedding occurs during months with evidence of infection on farms;
- Pacific salmon can use all channels in the Discovery Islands area; and

 Wild Sockeye Salmon and Sockeye Salmon produced through enhancement are not differentiated for the purpose of this risk assessment.

Likelihood of exposure

Table 11 presents the main factors contributing to and limiting the likelihood of Fraser River Sockeye Salmon to be exposed to PRV attributable to Atlantic Salmon farm(s) in the Discovery Islands area. Those factors were used to determine the likelihood and uncertainty rankings based on definitions in Tables 2, 5 and 6.

Table 11. Factors contributing to and limiting the likelihood that Fraser River Sockeye Salmon would be exposed to piscine orthoreovirus released from infected Atlantic Salmon farm(s) in the Discovery Islands area under the current farm practices.

Co	Contributing factors		miting factors
•	Juvenile and adult Fraser River Sockeye Salmon migrate through the Discovery Islands area every year;	•	Atlantic Salmon farms are not found in all channels of the Discovery Islands area; and
•	All Atlantic Salmon farms in the Discovery Islands area are anticipated to become infected with PRV within 100-200 days post-seawater transfer; and	•	Atlantic Salmon farms occupy a very small surface area and volume of the Discovery Islands area and width of channels.
•	There is temporal overlap between Fraser River Sockeye Salmon migration (May through October) and the presence of PRV on Atlantic Salmon farms in the Discovery Islands area.		

Two exposure groups were assessed: (1) juvenile Fraser River Sockeye Salmon; and (2) adult Fraser River Sockeye Salmon. Waterborne exposure is considered as the most relevant exposure route for Fraser River Sockeye Salmon in the context of this risk assessment.

Exposure of juvenile Fraser River Sockeye Salmon

It was concluded that the likelihood of at least one juvenile Fraser River Sockeye Salmon to be exposed to PRV attributable to Atlantic Salmon farms located in the Discovery Islands area through waterborne exposure is **extremely likely** under the current farm practices given the temporal overlap with reports of PRV on farms. This conclusion was made with **reasonable certainty** given abundant and robust data documenting the presence of juvenile Sockeye Salmon in the Discovery Islands area but lack of knowledge on the spatial and temporal distribution in proximity to farms and PRV survival in the marine environment.

Exposure of adult Fraser River Sockeye Salmon

It was concluded that the likelihood of at least one adult Fraser River Sockeye Salmon to be exposed to PRV attributable to an Atlantic Salmon farm located in the Discovery Islands area through waterborne exposure is **extremely likely** under the current farm practices given the temporal overlap with reports of PRV on farms. This conclusion was made with **reasonable certainty** given abundant and robust data documenting the presence of adult Sockeye Salmon in the Discovery Islands area but lack of knowledge on the spatial and temporal distribution in proximity to farms and PRV survival in the marine environment.

INFECTION ASSESSMENT

546 Question

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- 547 Assuming that at least one Fraser River Sockeye Salmon has been exposed to PRV released
- from Atlantic Salmon farms in the Discovery Islands area, what is the likelihood that at least one
- 549 will become infected?

550 Considerations

- 551 The infection assessment consists of determining the likelihood that Fraser River Sockeye
- 552 Salmon will be exposed to PRV at a concentration and for a duration sufficient to cause
- 553 infection.
- 554 Considerations include Sockeye Salmon susceptibility to PRV infection; PRV infection
- dynamics; oceanographic and environmental conditions; PRV minimum infectious dose;
- estimated PRV waterborne concentration attributable to Atlantic Salmon farms; hydrodynamic
- 557 dispersal; and estimated potential duration of exposure.

558 Sockeye Salmon susceptibility to PRV infection

- 559 Sockeye Salmon susceptibility to PRV infection is demonstrated by the following cohabitation
- study and detections in Sockeye Salmon sampled in the field.
- 561 PRV negative Atlantic and Sockeye salmon sentinels cohabitated with western North American
- 562 PRV positive Atlantic Salmon donors became infected with the virus after four weeks of
- 563 cohabitation in seawater (Garver et al., 2016a) providing evidence of Sockeye Salmon
- 564 susceptibility to PRV. Other studies also reported PRV infections in Sockeye Salmon but
- through intraperitoneal injections (Garver et al., 2016b; Polinski et al., 2016) which do not mimic
- 566 natural transmission pathways.
- 567 Sockeye Salmon appears to be less susceptible to PRV infections than Atlantic Salmon given
- lower prevalence and viral load and given that infections appear to take longer to develop
- (Garver et al., 2016a; Polinski and Garver, in preparation). For instance, based on a
- 570 cohabitation study with PRV-infected Atlantic Salmon, 40% (4/10) of Sockeye Salmon sentinels
- 571 compared to 100% (15/15) of Atlantic Salmon sentinels became infected with PRV after four
- weeks of cohabitation (Garver et al., 2016a). Additionally, PRV viral load peaked in 12 weeks in
- 573 Sockeye Salmon sentinels compared to 6 weeks in Atlantic Salmon sentinels, and maximum
- 574 viral loads remained lower in blood and kidney in Sockeye Salmon sentinels compared to
- 575 Atlantic Salmon sentinels (Garver et al., 2016a). Finally, some Sockeye Salmon appeared to be
- 576 refractory to PRV infection or we able to clear the infection (Garver et al., 2016a).
- 577 PRV genetic material has also been detected in Fraser River Sockeye Salmon sampled in BC
- 578 waters (Jeffries et al., 2014; Miller et al., 2014; Marty et al., 2015; Furey, 2016; Morton et al.,
- 579 2017; Teffer et al., 2017; Stevenson, 2018).

Infection dynamics of PRV

- 581 Polinski and Garver (in preparation) summarized the dynamics of PRV infections as observed in
- 582 Atlantic Salmon in three main phases: (1) early entry and dissemination; (2) peak systemic
- 583 replication; and (3) long-term persistence.
- During the early entry and dissemination phase, which typically lasts two to three weeks at 12°C, the virus enters the host, replicates and disseminates into blood cells. The virus

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- is not likely being shed into the environment to a high degree during this phase (Polinski et al., in press).
 - During the peak systemic replication phase, which typically lasts two to three weeks at 12°C, substantial PRV replication takes place within erythrocytes (Finstad et al., 2014; Wessel et al., 2015; Haatveit et al., 2017; Polinski et al., in press) leading to the highest systemic blood loads of PRV.
 - During the long-term persistence phase there is a reduction in viral protein production but large quantities of genomic PRV material remain associated with the erythrocyte cell fraction (Haatveit et al., 2017; Lund et al., 2017; Polinski et al., in press). Shedding of the virus is thought to be minimal during this phase and may even cease entirely over time (Garver et al., 2016a).

Oceanographic and environmental conditions

- Water temperatures in the Discovery Islands area vary both seasonally and regionally with
- recorded temperatures ranging between 3 and 24°C (Chandler et al., 2017). Monthly water
- 600 temperature in the top 15 m of Atlantic Salmon farms in the Discovery Islands area ranges from
- 601 7.6 \pm 2.3°C to 11.5 \pm 3.3°C (mean \pm std) (Chandler et al., 2017).
- Water salinity in the Discovery Islands area varies considerably by season (due to river runoff of
- snowmelt), by depth (due to the estuarine circulation), and by location (as some narrow
- 604 channels are extremely well mixed vertically) ranging from close to zero to 32. Monthly salinity
- in the top 15 m of Atlantic Salmon farms in the Discovery Islands area ranges from 28.9 ± 7.3 to
- 606 29.9 ± 8.7 (mean \pm std) (Chandler et al., 2017).
- Whether salinity or temperature influences the survival of PRV in the marine environment is not
- 608 known. However, the transmission of PRV to Atlantic Salmon in the Discovery Islands area
- 609 demonstrates that the oceanographic and environmental conditions are conducive for
- 610 transmission.

611 PRV minimum infectious dose

- No studies have attempted to determine the minimum dose required to infect Sockeye Salmon
- 613 with PRV.

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- 614 In Atlantic Salmon, preliminary evidence using PRV from Pacific Canada suggests that ≤10³
- 615 PRV particles are sufficient to initiate infection by intra-peritoneal injection (Polinski, unpublished
- data reported in Polinski and Garver (in preparation)). However, injections are not
- 617 representative of natural exposure and consequently the amount of PRV known to cause
- 618 infection by injection cannot be extrapolated to a more environmental relevant exposure route.
- 619 In Pink Salmon (O. gorbuscha), bath exposures to 1,000 purified PRV particles per mL for one
- hour failed to infect 1 g fish (n=20) in seawater up to six weeks after exposure (Richard,
- 621 Polinski, and Garver, unpublished data reported in Polinski and Garver (in preparation)),
- 622 providing a better representation of a natural exposure route.
- 623 The minimum dose required to induce PRV infection by immersion or ingestion in Sockeye
- 624 Salmon remains unknown, but is likely dependent upon the route of virus exposure, host
- 625 condition, stock, and species (Polinski and Garver, in preparation).

Estimated PRV waterborne concentration attributable to Atlantic Salmon farms

- 627 Quantifying the infection pressure from an infected farm requires estimations of the number of
- 628 infected fish on farm, the shedding rate in infected-fish and the volume of the farm.

- 629 Although the average volume of Atlantic Salmon farms in the Discovery Islands area has been
- estimated to be approximately 195,000 m³ (Mimeault et al., 2017) and that PRV prevalence on
- an infected Atlantic Salmon farm can be expected to reach 100% at some point within the
- 632 production cycle (see Exposure Assessment), the viral shedding rate in PRV-infected Atlantic
- 633 Salmon (or other salmonids) has not been quantified (Polinski and Garver, in preparation).
- 634 Consequently, it is not possible to estimate the infection pressure from a PRV-infected Atlantic
- 635 Salmon farm in the Discovery Islands area.

Hydrodynamic dispersal

- 637 Modelling the hydrodynamic dispersion of a pathogen in the marine environment requires an
- ocean and circulation model, the infection pressure attributable to the source and information
- about the survival of the pathogen in the marine environment.
- There is an existing ocean and circulation model available for the Discovery Islands area
- 641 (Foreman et al., 2012) that has been used to model hydrodynamic dispersion of infectious
- hematopoietic necrosis virus (IHNV) between farms (Foreman et al., 2015a) and dispersion of
- 643 IHNV (Mimeault et al., 2017) and Aeromonas salmonicida (Mimeault et al., in review-a) in the
- 644 Discovery Islands area.

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- Nevertheless, it was not possible to model the dispersal of PRV from infected Atlantic Salmon
- 646 farms in the Discovery Islands area for this risk assessment given that the viral infection
- 647 pressure attributable to a PRV-infected farm cannot be estimated (see section on Estimated
- 648 PRV concentration attributable to Atlantic Salmon farms) and there are no data on the survival
- 649 (or decay rate) of PRV in the marine environment (Polinski and Garver, in preparation).

Estimated duration of exposure

The potential duration that Fraser River Sockeye Salmon could be exposed to PRV released from an Atlantic Salmon farm in the Discovery Islands area depends on the time Fraser River Sockeye Salmon spend in the Discovery Islands area in proximity of infected farm(s) and the time an infected farm remains infectious.

Duration of PRV infections on Atlantic Salmon farms

Once infected, the on-going persistence of PRV infections in Atlantic Salmon has been demonstrated over 59 weeks under experimental conditions (Garver et al., 2016a) and five months under field conditions (Di Cicco et al., 2017). However, as mentioned in the Release Assessment section, it is hypothesized that horizontal transmission primarily occurs between 3 to 15 weeks following infection, after which the potential for natural shedding becomes severely reduced (Polinski and Garver, *in preparation*).

Residence time of Fraser River Sockeye Salmon in Discovery Islands area

Grant et al. (2018) estimated the residence time of juvenile and adult Sockeye Salmon in the Discovery Islands area, from which Mimeault et al. (2017) estimated, assuming a constant migration speed and unidirectional movement, that juveniles could encounter farms over three to eight days while returning adults could encounter farms over two days during their migration through the Discovery Islands area.

Fraser River Sockeye Salmon in proximity to Atlantic salmon farms

In a recent telemetry study, the median travel time of juvenile Fraser River Sockeye Salmon (n=21) from Hoskyn Channel to Okisollo Channel (approximately 25 km and including seven salmon farms) was estimated to be 31 hours (Rechisky et al., 2018). From the eastern to the western end of the Okisollo Channel (approximately 4 km and including three salmon farms)

median travel time of juvenile Fraser River Sockeye Salmon (n=20) was estimated to be 6 hours. In the same study, the median time juvenile Sockeye Salmon spent near the Venture Point (n=17) or Brent Islands (n=13) farms were respectively 4.5 minutes (range: 0 to 12) and 4.2 minutes (range: 0 to 24) (Rechisky et al., 2018) suggesting short exposure time. However, given that farms were fallow at the time of the study (Rechisky et al., 2018), it is possible that exposure time would be different when farms are stocked.

Assumptions

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- Sockeye Salmon have been exposed to PRV released from Atlantic Salmon farm(s) in the Discovery Islands area;
- All Fraser River Sockeye Salmon are assumed to be equally susceptible to PRV regardless of life stage or stock of origin;
- Juvenile and adults Fraser River Sockeye Salmon are considered naïve to PRV when migrating through the Discovery Islands area; and
- PRV is dispersed throughout the Discovery Islands area from infected Atlantic Salmon farms.

Likelihood of infection

Table 12 presents the main factors contributing and limiting the likelihood that Fraser River Sockeye Salmon would become infected with PRV released from Atlantic Salmon farm(s) located in the Discovery Islands area. Those factors were used to determine likelihood and uncertainty rankings based on definitions in Tables 2, 5 and 6.

Table 12. Factors contributing to and limiting the likelihood that Fraser River Sockeye Salmon would become infected with PRV released from infected Atlantic salmon farms in the Discovery Islands area under current farm practices.

Contributing factors Limiting factors Based on a telemetry tracking study, juvenile Sockeye Salmon are susceptible to PRV; Sockeye Salmon spend limited time (minutes) Based on juvenile swimming speed and in the vicinity of fallowed farms; distance it is estimated that juvenile Median travel time of juvenile Fraser River Sockeye Salmon could encounter Atlantic Sockeye Salmon (n=21) from Hoskyn Salmon farms over three to eight days Channel to Okisollo Channel (approximately during their migration through the 25 km and including seven salmon farms) Discovery Islands area; was estimated to be 31 hours; It is estimated that returning adult Based on laboratory studies, PRV-infected Sockeye Salmon could encounter Atlantic Atlantic Salmon appear to be most contagious Salmon farms over two days during their between 3 and 15 weeks following PRV migration through the Discovery Islands infection, after which the potential for horizontal area; transmission is severely reduced; and All Atlantic Salmon farms in the Discovery Sockeye Salmon appears to be less Islands area are anticipated to become susceptible to PRV infections than Atlantic infected with PRV within 100-200 days Salmon given lower prevalence and viral load post-seawater transfer; and and given that infections appear to take longer PRV prevalence in farmed Atlantic to develop. Salmon in the marine environment is

expected to reach 100% approximately 200-300 days post seawater transfer.

- 696 Likelihood of infection was considered for two exposure groups: (1) juvenile Fraser River 697 Sockeye Salmon; (2) adult Fraser River Sockeye Salmon.
- It was concluded that the likelihood of at least one Fraser River Sockeye Salmon, at either the juvenile or adult life stage, to become infected with PRV attributable to Atlantic Salmon farms in the Discovery Islands area through waterborne exposure under the current farm practices is very likely given that Sockeye Salmon are susceptible to PRV infection and have been shown
- to become infected in cohabitation studies. This conclusion was made with **high uncertainty** given incomplete and highly variable data and that expert opinions vary considerably. Whether
- 704 exposure to PRV at environmentally relevant concentrations around the farms and for the period
- of time that Fraser River Sockeye Salmon migrate through the Discovery Islands area where
- farms are present (three to eight days for juveniles, two days for adults) will result in infection in
- 707 Sockeye Salmon is not known.

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OVERALL LIKELIHOOD ASSESSMENT

- 709 The estimated likelihoods were combined as per the combination rules described in the
- 710 methodology section. The combined likelihood for the release assessment was determined by
- adopting the highest likelihood ranking among the release pathways. The combined likelihood
- 712 for each exposure group was determined by adopting the lowest ranking among the farm
- 713 infection, release, exposure and infection assessments.
- 714 Table 13 summarizes the likelihood assessment. Overall, it was concluded that the likelihood
- 715 that at least one Fraser River Sockeye Salmon would become infected with PRV released from
- 716 Atlantic Salmon farms in the Discovery Islands area is very likely for both exposure groups.
- 717 This conclusion is driven by the likelihood of infection which is highly uncertain given the lack of
- 718 data about PRV shedding rates from PRV-infected Atlantic Salmon and the minimum dose of
- 719 PRV required to infect Sockeye Salmon.

Table 13. Summary of the likelihood and uncertainty rankings for the likelihood assessment of the piscine orthoreovirus risk assessment. Descriptions of the uncertainties can be found with each likelihood assessment steps; uncertainties are not combined. Estimates are reported in white cells and likelihood combination results are reported shadowed cells under the "Rankings" column.

Steps		Ren	kinge			
Farm infection assessment	Likelihood of farm infection		ely likely ertainty)			
	Release pathways	Farmed Atlantic Salmon	Mechanical vectors and fomites			
Release assessment	Likelihood of release	Extremely likely (high certainty)	Unlikely (reasonable uncertainty)			
	Combined likelihoods of release	Extremely likely				
	Exposure groups	At least one juvenile Fraser River Sockeye Salmon	At least one adult Fraser River Sockeye Salmon			
Exposure and infection assessments	Likelihood of exposure	Extremely likely (reasonable certainty)	Extremely likely (reasonable certainty)			
	Likellhood of infection	Very likely (high uncertainty)				
Combined exposure and infection likelihoods for each exposure group		Very likely	Very likely			
Combined likelihoods (farm infection, release, exposure and infection) for each exposure group		Very likely	Very likely			

CONSEQUENCE ASSESSMENT

The consequence assessment aims to determine the potential magnitude of impacts of PRV attributable to Atlantic Salmon farms in the Discovery Islands area on the abundance and diversity of the Fraser River Sockeye Salmon.

Based on the likelihood assessment, it was determined that it is very likely that at least one Fraser River Sockeye Salmon would become infected with PRV released from Atlantic Salmon farms in the Discovery Islands area given that all farms could become infected with PRV after seawater transfer of Atlantic Salmon, that PRV infections could happen at any months of the year, and that infections can persist and given Sockeye Salmon susceptibility to PRV infection.

Assuming that at least one Fraser River Sockeye Salmon would have been infected with PRV attributable to infected Atlantic Salmon farms, the consequence assessment explores the potential magnitude of impacts to the number of returning adults and diversity of Fraser River Sockeye Salmon.

737 QUESTION

- 738 Assuming that at least one susceptible Fraser River Sockeye Salmon has been infected with
- 739 PRV released from infected Atlantic Salmon, what is the potential magnitude of impact on the
- 740 number of returning adults and diversity of Fraser River Sockeye Salmon?

741 CONSIDERATIONS

- 742 Considerations include pathogenicity and virulence of PRV; and PRV prevalence in Sockeye
- 743 Salmon.

744 Pathogenicity and virulence of PRV

- 745 To date, PRV1 is the only genogroup detected in North America (Polinski and Garver, in
- 746 preparation) hence the focus of this risk assessment. Refer to Polinski and Garver (in
- 747 preparation) for a summary of the state of knowledge related to the pathogenicity of other PRV
- 748 genogroups in different salmonid species and regions.
- 749 Briefly, PRV1 has been demonstrated to be an etiological component of heart and skeletal
- 750 muscle inflammation (HSMI) in farmed Atlantic Salmon in Norway (Wessel et al., 2017) and is a
- 751 putative contributing factor in severe cardiomyopathy in farmed Atlantic Salmon in Pacific
- 752 Canada (Di Cicco et al., 2017; Di Cicco et al., 2018). PRV1 has also been suggested to be a
- 753 contributing factor in jaundice/anemia in farmed Chinook Salmon (O. tshawytscha) in Pacific
- 754 Canada (Di Cicco et al., 2018).
- 755 However, under experimental conditions with Atlantic Salmon, PRV from Pacific Canada was
- 756 highly infectious but did not cause HSMI (Garver et al., 2016a), did not result in impaired
- 757 respiratory function (Zhang et al., in press) and was of low virulence causing only minor focal
- heart inflammation without significant transcriptional induction of immune genes (Polinski et al.,
- 759 in press).

760 Farmed Atlantic Salmon

- 761 In Norway, most farmed Atlantic Salmon become PRV positive but only some develop the
- disease (Polinski and Garver, in preparation). While HSMI is common in farmed Atlantic Salmon
- in Norway (Kongtorp et al., 2004a; Kongtorp et al., 2004b; Kongtorp et al., 2006; Palacios et al.,
- 764 2010), it is not clear why some experience high losses and others do not (Polinski and Garver,
- 765 in preparation).
- 766 In contrast, while most farmed Atlantic Salmon in Pacific Canada also become PRV positive,
- 767 clinical HSMI outbreaks as in Norway have not been reported (Polinski and Garver, in
- 768 preparation) but subclinical farm-level cases of HSMI-like disease have been suggested for
- 769 which PRV may or may not be a causative factor (Di Cicco et al., 2017; Di Cicco et al., 2018;
- 770 Polinski et al., in press).
- 771 No fish health events nor mortality events have been attributed to HSMI on Atlantic Salmon
- 772 farms in BC.

773 Sockeye Salmon

- 774 Of most relevance to this risk assessment are the consequences of PRV infection in Sockeye
- 775 Salmon. To date, there is no evidence that PRV causes disease in Sockeye Salmon despite
- 776 successful infection with the virus under experimental conditions (Garver et al., 2016a; Garver
- 777 et al., 2016b; Polinski et al., 2016).

- 778 Sockeye Salmon post-smolts (40 g) challenged by intraperitoneal injections with a PRV
- 779 inoculum prepared from infectious Atlantic Salmon developed considerable blood and kidney
- 780 PRV loads but no weight loss, morbidity or pathology could be attributed to the virus over 62
- 781 days after challenge (Polinski et al., 2016). Despite high viral loads, PRV only induced a weak
- 782 host response in head kidneys within the first three to four weeks of infection and the presence
- 783 of PRV did not change the host response to a superinfection with infectious hematopoietic
- 784 necrosis virus (Polinski et al., 2016).
- 785 In another laboratory study, PRV negative Atlantic and Sockeye salmon (sentinels) were
- 786 cohabitated in seawater with PRV positive Atlantic Salmon (75 g) (donors) injected with an
- 787 inoculum prepared from highly PRV infective Atlantic Salmon. Despite high prevalence and
- 788 persistence of PRV in blood and kidney of both sentinel species over 59 weeks, no microscopic
- 789 lesions, disease or mortality could be attributed to the virus (Garver et al., 2016a).
- 790 Chinook Salmon, Sockeye Salmon and Atlantic Salmon challenged by intraperitoneal injections
- 791 with a PRV inoculum prepared from jaundiced Chinook Salmon did not develop clinical jaundice
- 792 despite testing positive for PRV five months after challenge (Garver et al., 2016b).
- 793 Finally, preliminary data indicate that PRV infections are inconsequential to Sockeye Salmon
- 794 respiratory function (Polinski et al. in preparation reported in Polinski and Garver (in
- 795 preparation)).

- 796 Overall, the results from the above laboratory studies suggest that PRV from Pacific Canada is
- 797 infectious but of low virulence to Sockeye Salmon (Garver et al., 2016a; Polinski et al., 2016;
- 798 Polinski and Garver, in preparation). Additionally, the presence of PRV on or in the gills had no
- 799 significant effects on the likelihood that returning adult Fraser River Sockeye Salmon from
- 800 Chilko or Shuswap Lake stocks would reach their spawning grounds (Miller et al., 2014).

PRV prevalence in Sockeye Salmon

- 802 Polinski and Garver (in preparation) summarized PRV screening results in Pacific Salmon
- 803 sampled from Alaska, British Columbia and Washington from which they estimated an overall
- PRV prevalence of 1.4% in Sockeye Salmon based on results from 12 independent studies.
- 805 Table 14 summarises the PRV screening and positive detection in Sockeye Salmon per life
- stage and environment. Of the 6693 Sockeye Salmon screened for PRV, 4725 have been
- attributed to the Fraser River. With a total of 86 positive detections in Fraser River Sockeye
- 808 Salmon, the overall PRV prevalence in Fraser River Sockeye Salmon is estimated to be 1.8%.
- 809 Most positive detections were reported in returning adults (83/86) with respective PRV
- prevalence of 0.1% and 4.2% in juveniles and adults Fraser River Sockeye Salmon.
- 811 PRV prevalence in juvenile Fraser River Sockeye Salmon is similar in freshwater (0.1%) and
- seawater (0.2%) while in returning adults PRV prevalence in freshwater (1.3%) is lower than in
- seawater (12.1%). However, 98% (63/64) of positive detections in returning adult Fraser River
- 814 Sockeye Salmon sampled in seawater were from gill biopsies and might not all be indicative of
- 815 systemic infections as liver samples taken at the time of gill biopsies, as well as subsequently in
- 816 the Fraser River, were negative (Polinski and Garver, in preparation).

 Table 14. PRV screening and positive detections in Sockeye Salmon of Alaska, British Columbia (BC), and Washington by life stage and/or sampling environment. Adapted from Polinski and Garver (in preparation) which includes results from Jeffries et al. (2014); Miller et al. (2014); Marty et al. (2015); Furey (2016); Morton et al. (2017); Teffer et al. (2017); Nekouei et al. (2018); Purcell et al. (2018); Stevenson (2018); Thakur et al. (in press); Hrushowy (2018); and Johnson (unpublished).

		Number of PRV positive fish/number fish screened (%)						
Sockeye Salmon		Fry Juveniles			Ad	Total		
		Freshwater	Freshwater	Seawater	Seawater	Freshwater	lotai	
41 1 50	Ву	3/89	1/1879	8/1943	64/560	21/2352		
Alaska, BC	group	(3.4%)	(0.1%)	(0.4%)	(11.4%)	(0.9%)	97/6693	
and	Sub-	3/89	9/3822		85/2912		(1.4%)	
Washington	total	(3.4%)	(0.2%)		(2.9%)			
	Ву		1/1505	2/1258	64/531	19/1431		
Fraser River Sockeye	group		(0.1%)	(0.2%)	(12.1%)	(1.3%)	86/4725	
	Sub-		3/2763		83/1962		(1.8%)	
Salmon only	total		(0.1	%)	(4			

Polinski and Garver (*in preparation*) also summarized PRV screening results by Fraser River Sockeye Salmon stocks. To date, of the 4725 Fraser River Sockeye Salmon screened for PRV, 4337 have been genetically attributed to specific stocks from the Fraser River, representing 22 of the 24 Fraser River Sockeye Salmon conservation units (CUs) (Table 15).

Positive detections have been reported in six Fraser River Sockeye Salmon stocks (Adams, Chilko Lake, Cultus Lake, Nadina River, Stuart Lake and Shuswap Lake) representing five to seven of the 24 conservation units. Given the low sample size of fish screened for PRV in some stocks and absence of screening for PRV in other stocks, PRV may also be present in other stocks and conservation units.

Table 15. Distribution of PRV detection across Fraser River Sockeye Salmon stocks and the 24 Wild Salmon Policy Conservation Units. Sources: 2017 integrated biological status as per DFO (2018a). PRV screening results as per Jeffries et al. (2014); Miller et al. (2014); Marty et al. (2015); Furey (2016); Morton et al. (2017); Teffer et al. (2017); Nekouei et al. (2018); Stevenson (2018). EStu: Early Stuart; ES: Early Summer; S: Summer; L: Late; NA; Not applicable, —: no tests, * questionable positive detection in Marty et al. (2015).

2017	Conservation unit-	Stock screened	PRV screening results			
status	Management unit	for PRV	Juveniles	Adults		
1100	Bowron-ES	Bowron	0/9			
Red	Cultus-L	Cultus	1/62			
Red	Taseko-ES			est nip		
Red	Widgeon-River					
Red	Harrison (U/S)-L	Weaver	0/8			
Red	Seton-L	Portage	0/35			
Red	Takla-Trembleur-EStu	Early Stuart, Late	0/4	1/191		
RAA	Takla-Trembleur-Stuart-S	Stuart & Misc.1	0/4	1/101		
		Quesnel	0/22	0/297		
		Horsefly	0/148			
R A	Quesnel-S	Mitchell	0/119	-		
		Blue Lead	0/1			
		Wasko-Roaring	0/16			

PRV risk assessment

DRAFT (DO NOT CITE OR DISTRIBUTE)

	Amber Nahatlatch-ES Amber North Barriere-ES		Nahatlatch River	0/16	-
Am	per	North Barriere-ES	Fennell		
			Thompson	0/75	
Am	ber	Kamloops-ES	Raft	0/18	
			Upper Barrier	0/3	**
Am	ber	Lillooet-Harrison-L	Birkenhead	0/77	0/11
Λ	ber	Shuswap-ES	Scotch ²	0/72	0/8
AIII	bei	Shuswap-ES	Seymour ²	0/134	
			Adams	1/370	0/2
		Character Committee	Shuswap ³	0/398	49/304
Α	G	Shuswap Complex-L	Eagle	0/6	
			Little	0/5	
Α	G	Nadina-Francois-ES	Nadina	0/60	14/60
		01.111	Dolly Varden	0/86	-
Α	G	Chilliwack-ES	Chilliwack Lake	0/34	to the same of the
A	G	Francois-Fraser-S	Stellako	0/137	0/10
Α	G	Anderson-Seton-ES	Gates	0/65	0/19
Α	G	Harrison (D/S)-L	Big Silver	0/4	
Gre	een	Pitt-ES	Pitt	0/79	
Gre	en	Harrison River - River	Harrison ⁵		0/103
Gre	een	Chilko-S and Chilko-ES	Obilla-6	0/4049	15/050
	D	Chilko-ES	Chilko ⁶	0/1018	15/250
			2/3082	66/1255	
5ub-1	total by	/ life stage		(0.1%)	(5.3%)
Total			68/4337 (1.6%)		

- *Takla-Trembleur-EStu" CU or the "Takla-Trembleur-Stuart-S" CU. We also include juvenile fish sampled from Sandpoint Creek, Five Mile Creek, Middle River, and Dist-Sinta Creek (n=1 per stock) as part of this combined TTE or TTS CU.
- We have assumed that samples identified as belonging to Scotch Creek and Seymour River are from
 the early summer timed CU "Shuswap-ES"; however we note that both of these streams also produce a
 smaller late-timed run that is part of the "Shuswap Complex-L" CU.
 - ³ We have included stocks from the Middle Shuswap River (n=53) in this categorization, although it is possible that some of these fish may be of the Shuswap-ES CU.
- 4 Positive detection of PRV nucleic acid in only one of two technical replicates which was noted as inconclusive by the authors (Mary et al., 2015).
- 848 ⁵We have assumed that adult samples identified as belonging to the Harrison stock are part of the *Harrison River – River" CU.
- 850 6 We are unable to distinguish whether samples identified as belonging to the Chilko stock are part of the 851 "Chilko-S" CU or the "Chilko-ES" CU.

ASSUMPTIONS

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 Results from laboratory studies on the impact of PRV infection in Sockeye Salmon are indicative of what occurs in the marine environment;

- Prevalence of PRV in sample is representative of the prevalence of the whole stock in all
 years;
- Juvenile and adult Fraser River Sockeye Salmon are assumed to be equally susceptible to
 PRV; and
- All Fraser River Sockeye Salmon stock have the same susceptibility.

MAGNITUDE OF CONSEQUENCES

- The consequence assessment explores the potential magnitude of impact to the abundance
- and diversity of Fraser River Sockeye Salmon resulting from juvenile and adult Fraser River
- 863 Sockeye Salmon infected with PRV released from Atlantic Salmon from all farms located in the
- 864 Discovery Islands area.
- The likelihood assessment concluded that it is very likely that at least one Fraser River Sockeye
- 866 Salmon would get infected with PRV attributable to Atlantic Salmon farms in the Discovery
- 867 Islands area. It is however not possible to determine the proportion of migrating Fraser River
- 868 Sockeye Salmon that would get infected with PRV given the significant knowledge gaps related
- to the estimation of the PRV infection pressure from an Atlantic Salmon farm, the minimum PRV
- 870 dose required to infect Sockeye Salmon and the interactions of Sockeye Salmon with Atlantic
- 871 Salmon farms. Predicated on the prevalence of PRV in the population, any effects, if any, would
- be limited to the fish infected with PRV attributable to Atlantic Salmon farms in the Discovery
- 873 Islands area.

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- The potential magnitude of consequences on both the abundance and diversity of Fraser River
- 875 Sockeye Salmon resulting from infection with PRV attributable to Atlantic Salmon farms in the
- 876 Discovery Islands area was determined for juvenile and adult Fraser River Sockeye Salmon.
- 877 Rankings were determined referring to definitions of consequence to abundance (Table 3),
- 878 consequences to diversity (Table 4) and uncertainty (Table 5).

879 Juvenile Fraser River Sockeye Salmon

- 880 Lake-type juvenile Fraser River Sockeye Salmon migrate through the Discovery Islands area
- during their outmigration. Given the ubiquitous nature of PRV on Atlantic Salmon farms and its
- high prevalence and persistence on infected farms, it was concluded that it is very likely that at
- 883 least one juvenile Fraser River Sockeye Salmon would become infected during their
- outmigration. However, it is not possible to determine the proportion of the juveniles that could
- 885 become infected nor the potential for an infection acquired in the Discovery Islands area to
- 886 spread to other juvenile Fraser River Sockeye Salmon during migration at sea.
- 887 However, although the proportion of juvenile Fraser River Sockeye Salmon getting infected with
- 888 PRV attributable to Atlantic Salmon farms is unknown, only two positive PRV detections have
- been reported in juvenile Fraser River Sockeye Salmon sampled in seawater over a total of
- 890 1258 (0.2%) (Polinski and Garver, in preparation) (Table 14). Whether this low prevalence in
- 891 juveniles sampled at sea is an artefact of the short time period between potential infection and
- 892 screening is unknown but is a possibility as Garver et al. (2016a) demonstrated that several
- 893 weeks post exposure are necessary for detection of the virus in both Atlantic and Sockeye
- 894 salmon under experimental conditions. Regardless of the proportion infected, PRV from Pacific
- 895 Canada appears to be infectious but of low virulence under laboratory conditions (Garver et al.,
- 896 2016a; Garver et al., 2016b; Polinski et al., 2016; Polinski and Garver, in preparation).
- 897 Overall, the low prevalence, low virulence, absence of impact on respiratory performance of
- 898 PRV in Sockeye Salmon suggest a limited impact of PRV on the survival of Fraser River
- 899 Sockeye Salmon. It was therefore concluded that the potential magnitude of consequences to

- the abundance of Fraser River Sockeye Salmon would be **negligible**. This conclusion was made with **reasonable certainty** given abundant and robust data on the low prevalence and
- 902 virulence of PRV in Sockeye Salmon.
- 903 Juvenile Fraser River Sockeye Salmon from 22 conservation units have been screened for
- 904 PRV. Two PRV positive detections have been reported: one in the Cultus-L and one in the
- 905 Shuswap Complex-L conservation units (Table 14). However, given the low prevalence and
- 906 virulence of the virus in juvenile Sockeye Salmon, it was concluded that the potential magnitude
- of consequences to the diversity of Fraser River Sockeye Salmon would be negligible over two
- 908 generations (eight years). This conclusion was made with reasonable certainty given abundant
- and robust data on the low prevalence and virulence of PRV in Sockeye Salmon.

Adult Fraser River Sockeye Salmon

- 911 In any given year, between 10 and 96% of returning adult Fraser River Sockeye Salmon migrate
- 912 through the northern diversion route (Grant et al., 2018) and hence could be exposed to an
- 913 Atlantic Salmon farm in the Discovery Islands area. Given the ubiquitous nature of PRV on
- 914 Atlantic Salmon farms and its high prevalence and persistence on infected farms, it was
- 915 concluded that it is very likely that at least one adult Fraser River Sockeye Salmon would
- 916 become infected during their outmigration through the Discovery Islands area, it is however not
- 917 possible to determine the proportion of adults that could become infected due to Atlantic Salmon
- 918 farms in the Discovery Islands area.
- 919 Overall, the average PRV prevalence in adult Fraser River Sockeye Salmon is 4.2% with a
- 920 maximum of 12.1% in seawater. However, most (63/64) of the PRV positive detections reported
- 921 in returning adult Fraser River Sockeye Salmon sampled in seawater were from gill biopsies
- 922 (Miller et al., 2014). Liver samples taken at the same time of gill biopsies as well as
- 923 subsequently in the Fraser River were negative for PRV; suggesting that the PRV on or in the
- 924 gill tissues of these fish did not represent systemic infections nor did systemic infections likely
- 925 develop before returning fish reached their spawning grounds (Polinski and Garver, in
- 926 preparation).

- 927 Returning Fraser River Sockeye Salmon can travel the distance between the southeastern limit
- 928 of the Discovery Islands area and Mission in approximately three to four days (Grant et al.,
- 929 2018). The distance between Fraser River Sockeye Salmon spawning grounds and the ocean
- 930 ranges widely, from 40 km for the Widgeon Slough population to 1,200 km for the Early Stuart
- 931 population (Cohen, 2012b). Early Stuart River Sockeye Salmon took up to a month to reach
- their spawning grounds from the mouth of the Fraser River (Stoddard, 1993). Consequently,
- 933 depending on the stocks, returning adults can take up to 35 days to reach their spawning
- 934 grounds.
- 935 Given that under experimental conditions Sockeye Salmon required four weeks to develop
- 936 detectable PRV infections through cohabitation with Atlantic Salmon donors (Garver et al.,
- 937 2016a), that PRV transmission likely takes more than three weeks to occur following infection
- 938 (Polinski and Garver, in preparation) and that PRV prevalence in adult Fraser River Sockeye
- 939 Salmon sampled in freshwater is 1.3%, no significant spread of infection within the returning
- 940 adults prior to spawning is expected.
- 941 PRV infections had no significant effects on the likelihood that returning adult Fraser River
- 942 Sockeye Salmon from two different stocks would reach their spawning grounds (Miller et al.,
- 943 2014). In absence of additional data specific to PRV infections in adult Sockeye Salmon,
- 944 surrogate data based on different species or different life stages were also considered:

- Notwithstanding that PRV responses vary between salmon species, there are only rare
 occurrences of diseases associated with PRV in farmed Atlantic Salmon in BC despite the
 ubiquitous nature and high prevalence of the virus; and
 - Based on laboratory studies conducted with juvenile Sockeye Salmon, PRV from Pacific Canada appears to be infectious but of low virulence under laboratory conditions (Garver et al., 2016a; Garver et al., 2016b; Polinski et al., 2016; Polinski and Garver, in preparation), hence PRV is also expected to be of low virulence in adults.

Overall, regardless of the proportion of returning adult Fraser River Sockeye Salmon infected with PRV, the low prevalence, low virulence and absence of significant impact on the likelihood of reaching spawning grounds in PRV-infected Sockeye Salmon suggest a limited impact of PRV on the survival of Fraser River Sockeye Salmon. It was therefore concluded that the potential magnitude of consequences to the abundance of Fraser River Sockeye Salmon would be **negligible**. This conclusion was made with **reasonable uncertainty** given abundant and robust data on the low virulence of PRV in Sockeye Salmon but reliance on surrogate data for determining potential consequences.

Adult Fraser River Sockeye Salmon from nine conservation units have been screened for PRV. Positive detections were reported in four stocks representing four to six of the 24 Fraser River Sockeye Salmon conservation units (Table 14). However, since no significant spread of infection within the returning adults prior to spawning is expected and given the low virulence of the virus in Sockeye Salmon, it was concluded that the potential magnitude of consequences to the diversity of Fraser River Sockeye Salmon would be **negligible** over two generations (eight years). This conclusion was made with **reasonable uncertainty** given abundant and robust data on the low virulence of PRV in Sockeye Salmon but reliance on surrogate data for determining potential consequences.

RISK ESTIMATION

ABUNDANCE

The risk to the abundance of Fraser River Sockeye Salmon due to infections with PRV attributable to Atlantic Salmon farms in the Discovery Islands area (Table 16) was estimated using the risk matrix combining the results of the likelihood assessment and the results of the consequence assessment to Fraser River Sockeye Salmon abundance (Figure 3).

Table 16. Risk estimation to the abundance of Fraser River Sockeye Salmon resulting from piscine orthoreovirus attributable to Atlantic Salmon farms located in the Discovery Islands area of under current farm practices.

Exposure group	Likelihood assessment	Consequence assessment	Risk to Fraser River Sockeye Salmon abundance
Juvenile Fraser River Sockeye Salmon	Very likely	Negligible	Minimal
Adult Fraser River Sockeye Salmon	Very likely	Negligible	Minimal

Overall, it was concluded that, under the current farm practices, the risk to the abundance of Fraser River Sockeye Salmon as a result of a PRV infection attributable to Atlantic Salmon farms in the Discovery Islands area is **minimal**.

DIVERSITY

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The risk to the diversity of Fraser River Sockeye Salmon due to infections with PRV attributable to Atlantic Salmon farms in the Discovery Islands area (Table 17) was estimated using the risk matrix combining the results of the likelihood assessment and the results of the consequence assessment to Fraser River Sockeye Salmon diversity (Figure 4).

Table 17. Risk estimation to the diversity of Fraser River Sockeye Salmon resulting from piscine orthoreovirus attributable to Atlantic Salmon farms located in the Discovery Islands area of under current farm practices.

Exposure group	Likelihood assessment	Consequence assessment	Risk to Fraser River Sockeye Salmon diversity
Juvenile Fraser River Sockeye Salmon	Very likely	Negligible	Minimal
Adult Fraser River Sockeye Salmon	Very likely	Negligible	Minimal

It was concluded that, under the current farm practices, the risk to the diversity of Fraser River Sockeye Salmon as a result of a PRV infection attributable to Atlantic Salmon farms in the Discovery Islands area is **minimal**.

SOURCES OF UNCERTAINTIES

Total uncertainty includes both variability, which is a function of the system that is not reducible with additional measurements, and lack of knowledge that may be reduced with additional data or expert opinion (Vose, 2008). There are uncertainties associated with both the likelihood and consequence assessments.

LIKELIHOOD ASSESSMENT

The main uncertainties related to the likelihood assessment are attributed to:

- the source(s) and survival of PRV in the marine environment is unknown;
- the variability and knowledge gaps about precise migration routes of lake-type Fraser River Sockeye Salmon through the Discovery Islands area;
 - the shedding rates from PRV infected Atlantic Salmon are unknown; and
- the minimal infectious doses of PRV in Sockeye Salmon are unknown.

CONSEQUENCE ASSESSMENT

The main uncertainties in the consequence assessments for both abundance and diversity resulted from:

- the persistence of PRV infection in Sockeye Salmon is unknown;
- the lack of understanding of how PRV spreads within migrating fish populations; and
- minimal information on PRV prevalence and impact on different conservation units of Fraser River Sockeye Salmon.

1011	CONCLUSIONS
1012 1013 1014	The assessment concluded that PRV attributable to Atlantic Salmon farms in the Discovery Islands area poses minimal risk to Fraser River Sockeye Salmon abundance and diversity under the current farm practices.
1015 1016 1017 1018 1019	The attribution of the minimal risk was mainly influenced by the potential magnitude of consequences to Fraser River Sockeye Salmon. Despite concluding that it is very likely that Fraser River Sockeye Salmon would become infected with PRV attributable to Atlantic Salmon farms in the Discovery Islands area, the consequence of such infections to both Fraser River Sockeye Salmon abundance and diversity would be expected to be negligible.
1020 1021 1022 1023 1024 1025 1026 1027 1028	There are important sources of uncertainties associated to the determination of the risk to Fraser River Sockeye Salmon due to PRV attributable to Atlantic Salmon farms in the Discovery Islands area. The main uncertainties are related to shedding rate in PRV-infected Atlantic Salmon, PRV survival in the marine environment, and the minimum infectious doses of PRV required to infect Sockeye Salmon. Additionally, there is a lack of knowledge about the persistence of PRV infections in Sockeye Salmon, the spread of infections in migrating Fraser River Sockeye Salmon and impact on different conservation units of Fraser River Sockeye Salmon. Conclusions of this risk assessment should be reviewed as new research findings fill knowledge gaps.
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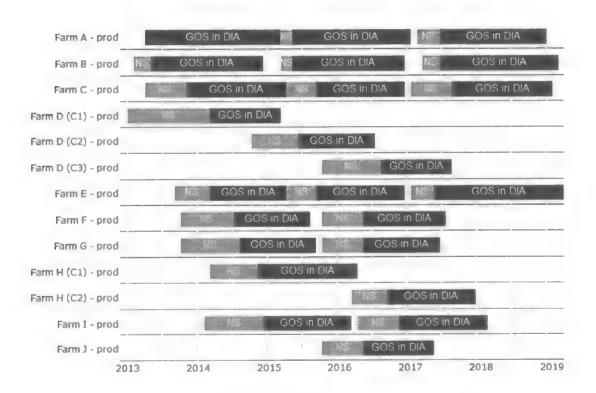
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APPENDICES 1256 APPENDIX A: ATLANTIC SALMON PRODUCTION CYCLES IN THE DISCOVERY 1257 **ISLANDS AREA** 1258 1259 Atlantic Salmon production cycles in the Discovery Islands area were summarized in November 2018 based on dates of fish transfers between January 2013 and November 2018. 1260 1261 Grow-out periods in the Discovery Islands area ranged between 12 and 23 months (average=17 1262 months, n=27 cycles) from the beginning of fish transfer to grow-out sites to the end of harvesting periods. Fish can be stocked between 2 and 14 months (average=7 months, n=23 1263 cycles) on nursery sites prior to being transferred to grow-out sites in the Discovery Islands 1264 1265 area. Between January 2013 and November 2018, fish transfers to grow-out sites in the Discovery 1266 Islands area occurred in every month of the year with most of them occurred in May and June 1267 (Figure 6). Within a given production cycle, fish are usually transferred within a given month but 1268 1269 can sometime extend over four months.



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Figure 6. Production cycles initiate between January 2013 and December 2017 on Atlantic Salmon farms in the Discovery Islands area. Only marine grow-out sites stocked with fish transferred from seawater nursery sites are included. For clarity, production cycles on any given farm are represented on a single row (Farm A to J) or multiple rows when nursery and grow-out periods overlap (farms D and H). Periods with fish stocked at seawater nursery sites are labelled as "NS" (light blue) and periods of grow-out sites in the Discovery Islands area are labelled "GOS" (dark blue). Data summarized in November 2018 including predicted harvest dates out to mid-2019. Data source for production cycles: Aquaculture Management, DFO.

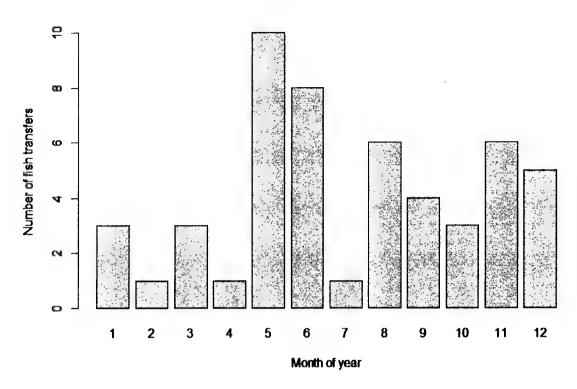


Figure 7. Atlantic Salmon transfers to marine grow-out sites in the Discovery Islands area between January 2013 and June 2018. Data includes first transfers over a total of 28 production cycles from hatcheries and seawater nursery sites to marine grow-out sites. Data provided by Aquaculture Management, DFO.

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1285 APPENDIX B: DFO AUDIT DEFICIENCIES

Table 18. Number of deficiencies identified during audits conducted by Fisheries and Oceans Canada on Atlantic Salmon farms 2011-2017 in British Columbia. Data provided by DFO Aquaculture Management (updated from Wade, 2017).

DFO audit deficiency categories	2011	2012	2013	2014	2015	2016	2017	Total
Carcass retrieval protocol or record keeping needs improvement	2	8	4	23	23	21	18	99
Current finfish licence was not posted at facility	0	0	2	0	1	1	3	7
Disease contingency or mass mortality information or records needs improvement	2	1	0	0	0	9	11	23
Fish euthanasia and/or methods not recorded	3	1	0	0	0	0	1	5
Footbaths or sanitizers needs improvement	0	1	3	11	3	4	1	23
Husbandry or record keeping as per COL Appendix VIII-A or VIII-B needs improvement	2	5	4	3	6	2	3	25
Lice protocol or lice records as per COL VII or VII-A needs improvement	21	17	15	18	19	9	26	125
Mooring signage needs improvement	21	6	7	6	9	6	3	58
Mortality assessment or classification needs improvement	0	0	0	0	0	0	0	0
Nutritional or medicated feed protocol concerns	0	0	2	1	3	0	1	7
Training documentation is not up-to-date	0	4	0	3	5	0	1	13
Transfer records are not complete or up-to-date	25	9	9	3	3	3	6	58
Visitor protocol communication needs improvement	7	2	4	2	0	0	1	16
Water quality monitoring, equipment or record keeping needs improvement	0	0	1	0	0	0	1	2
Wild fish mortality records need clarification	0	1	1	0	0	2	3	7
Total # deficiencies	83	55	52	70	72	57	79	468
# audits	58	102	96	99	110	108	111	682
# farms with deficiencies	40	35	31	41	45	41	29	262
Average # deficiencies/audit	1.43	0.54	0.54	0.71	0.65	0.54	0.71	0.73

National CSAS Process

Assessment of the risk to Fraser River sockeye salmon due to piscine orthoreovirus (PRV) transfer from Atlantic salmon farms located in the Discovery Islands area, British Columbia

AGENDA

January 28th to 30th, 2019 Mount Pleasant Conference Room Delta Hotels Vancouver Downtown Suites 550 West Hastings Street Vancouver, British Columbia V6B 1L6

	DAY 1	
	Monday, January 28, 2019	
13:00 - 13:15	Welcome, Introductions, Housekeeping & Review of Agenda	Gilles Olivier & Craig Stephen (Chairs)
13:15-13:30	CSAS Overview & Meeting Procedures	Gilles Olivier
13:30-13:45	Review Terms of Reference	Craig Stephen
13:45-14:00	Risk assessment process and linkages with the working papers	Ingrid Burgetz
14:00-14:30	Mark Polinski	
	BREAK	
14:45-15:45	Reviewer Presentations & Authors Response	Espen Rimstad, Niccolo Vendramin, <i>Ted Meyers</i>
15:45-16:45	Open Discussion & Preparation of Summary Bullets	Everyone
16:45-17:00	Summary & Adjournment	Gilles Olivier
	DAY 2	
	Tuesday, January 29, 2019	
8:30-8:45	Review of Day 1	Craig Stephen
8:45-9:30 Presentation #2: Assessment of the risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) on Atlantic Salmon farms in the Discovery Islands area, British Columbia		Caroline Mimeault
9:30-10:30	Reviewer Presentations & Author Response	Ian Gardner, Mark Powell, <i>Edmund Peeler</i>
	BREAK	
10:45-12:00	Open Discussion & Preparation of Summary Bullets	Everyone
	LUNCH	
13:00-14:00	Open Discussion & Preparation of Summary Bullets	Everyone
14:00-15:00	Science Advisory Report Development	Everyone
	BREAK	
15:15-16:30	Science Advisory Report Development	Everyone
16:30-17:00	Summary & Adjournment	Gilles Olivier

Italicized names represent reviewers that provided written comments only

· · · · · · · · · · · · · · · · · · ·	DAY 3	
	Wednesday, January 30, 2019	
8:30-8:45	Review of Day 2	Craig Stephen
8:45-10:00	Science Advisory Report Development	Everyone
	BREAK	
10:15-12:00	Science Advisory Report Development	Everyone
	LUNCH	
13:00-14:30	Science Advisory Report Development	Everyone
44.20.45.45	Final Canada	Craig Stephen & Gilles
14:30-15:15	Final Consensus	Olivier
	BREAK	
15:30-17:00	Conclusions & Next Steps	Gilles Olivier

List of Participants

(Attendees)

Name	Affiliation
	BC Centre for Aquatic Health Sciences
Alistair Struthers	Fisheries and Oceans Canada
	Cermaq Canada
	Pacific Salmon Foundation
Caroline Mimeault	Fisheries and Oceans Canada
	First Nations Fisheries Council of BC
Craig Stephen	Canadian Wildlife Health Cooperative
	Kintama Research
Espen Rimstad	Norwegian University of Life Sciences (NMBU)
France Boily	Fisheries and Oceans Canada
Gary Marty	BC Animal Health Centre
Gilles Olivier	Fisheries and Oceans Canada
	Fish Vet Group
lan Gardner	Atlantic Veterinary College UPEI
Ingrid Burgetz	Fisheries and Oceans Canada
Jay Parsons	Fisheries and Oceans Canada
	David Suzuki Foundation
Kendra Holt	Fisheries and Oceans Canada
Kristi Miller-Saunders	Fisheries and Oceans Canada
Kyle Garver	Fisheries and Oceans Canada
Lily Weber	Fisheries and Oceans Canada
Mark Polinski	Fisheries and Oceans Canada
Mark Powell	Institute of Marine Research Norway
Myron Roth	BC Ministry of Agriculture
Nathalie Bruneau	Canadian Food Inspection Agency
Nellie Gagne	Fisheries and Oceans Canada
Niccolo Vendramin	Technical University of Denmark
Simon Jones	Fisheries and Oceans Canada
	Veterinary Consultant
Stewart Johnson	Fisheries and Oceans Canada
	Grieg Seafood
Tony Farrell	University of British Columbia
Zac Waddington	Fisheries and Oceans Canada

(Comments only)

Name	Affiliation	
Edmund Peeler	Center for Environment Fisheries and Aquaculture Science (CEFAS)	
Ted Meyers	Alaska Department of Fish and Game	

Dickie, Catherine

From:

Moore, Wayne

Sent:

January-22-19 11:59 AM Lowe, Carmel; Parsons, Jay

To: Cc:

MacDougall, Lesley

Subject:

RE: UPCOMING PRV RISK ASSESSMENT - FW: Final Safe Work Procedure: Offsite

Stakeholder/Public Meetings with Clients Safety and Security Measures

Thanks....we will. We have been thinking about this.

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: January 22, 2019 2:57 PM

To: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca>; Parsons, Jay < Jay. Parsons@dfo-mpo.gc.ca>

Cc: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: UPCOMING PRV RISK ASSESSMENT - FW: Final Safe Work Procedure: Offsite

Stakeholder/Public Meetings with Clients Safety and Security Measures

Both

I let RMC here know that the PRV Risk Assessment is happening Mon-Wed next week. Rebecca asked if we had considered security – to which I said I wasn't sure as meeting is being led by NHQ - but that the meeting was by invitation only. In any case she asked that I share these safe work procedures developed for staff here who have to interact with 'unfriendly' clients – and request you pass them on to the Meeting Chairs.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

From: Kerr, Lisa < Lisa.Kerr@dfo-mpo.gc.ca>

Sent: January 22, 2019 11:28 AM

To: XPAC RMC Members < PACRMC@dfo-mpo.gc.ca>

Cc: Mah, Richard < Richard.Mah@dfo-mpo.gc.ca>; Lawrence, DJ < DJ.Lawrence@dfo-mpo.gc.ca> Subject: Final Safe Work Procedure: Offsite Stakeholder/Public Meetings with Clients Safety and Security Measures

Hi all,

As mentioned at the RMC meeting this morning, please find attached Safe Work procedures for the offsite meetings with Clients. The document includes lists of considerations and steps for before, during and after the event.

The document was prepared by Policy Branch, Communications and Safety and Security (DJ Lawrence) and the input was finalized into the attached document by Gilles Verret.

If you have any questions, pleas	se feel free to contact the Safety and Security	/ team or myself.
Thanks,	•	•
Lisa Kerr		
	No information has been removed or severed from t	his page

Dickie, Catherine

From:

MacDougall, Lesley

Sent:

January-29-19 7:39 AM

To:

Lowe, Carmel

Subject:

RE: Please do not distribute the email update on PRV that I sent you further!!

Hi Carmel - roger that.

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: January-29-19 7:37 AM

To: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: Please do not distribute the email update on PRV that I sent you further!!

Sent from my BlackBerry 10 smartphone on the Rogers network.

No information has been removed or severed from this page

Dickie, Catherine

From: Girouard, Louise

Sent: January-29-19 10:54 AM

To: Reid, Rebecca; Thomson, Andrew; Lowe, Carmel

Cc: Fogliato, Cara; Webb, Allison; Rainer, Michelle; Bate, Dan

Subject: RE: For URGENT Approval | News Release and MLs | PRV Media Briefing

Will do.

L

From: Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>

Sent: Tuesday, January 29, 2019 9:48 AM

To: Girouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>

Cc: Fogliato, Cara <Cara.Fogliato@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>;

Rainer, Michelle < Michelle.Rainer@dfo-mpo.gc.ca>; Bate, Dan < Dan.Bate@dfo-mpo.gc.ca>

Subject: Re: For URGENT Approval | News Release and MLs | PRV Media Briefing

Hi Louise - i approve, but for question 10, reference is made to 2017 investments in salmon. Can you also refer to sep in that same question, noting that is is in addition to our annual \$26M in the Region's SEP.

RR

Sent from my Samsung Galaxy smartphone.

----- Original message -----

From: "Girouard, Louise" < Louise. Girouard@dfo-mpo.gc.ca>

Date: 2019-01-29 8:59 AM (GMT-08:00)

To: "Reid, Rebecca" < Rebecca.Reid@dfo-mpo.gc.ca >, "Thomson, Andrew" < Andrew.Thomson@dfo-mpo.gc.ca >,

"Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca>

Cc: "Fogliato, Cara" < Cara. Fogliato@dfo-mpo.gc.ca>, "Webb, Allison" < Allison. Webb@dfo-mpo.gc.ca>,

"Rainer, Michelle" < Michelle.Rainer@dfo-mpo.gc.ca>, "Bate, Dan" < Dan.Bate@dfo-mpo.gc.ca>

Subject: For URGENT Approval | News Release and MLs | PRV Media Briefing

Good morning,

Please find attached, the PRV news release and media lines currently going through approvals in NHQ. Can you please review and let me know if you have any concerns?

Context: The Canadian Science Advisory Secretariat (CSAS) is holding a peer-review meeting in Vancouver, January 28-30, 2019, to review various scientific reports and provide advice on the risk to Fraser River sockeye salmon due to Piscine Orthoreovirus (PRV) transfer from Atlantic salmon farms located in the Discovery Islands area, British Columbia. A full report will be published on the CSAS website in late spring 2019.

A media technical briefing on the preliminary findings of the peer review meeting might be held on February 1, 2019 (TBC) in Vancouver and would include the participation of the two non-DFO co-chairs of the review. I am told that Andy may also participate if this goes ahead.

Thanks

Louise

Deadline: MINO is requesting to see the products by COB today.

Approvals:

Ingrid Burgetz, Manager, Aquaculture Science - approved Alistair Struthers, Director, Aquaculture Operations - approved John Campbell, DG, Aquaculture Management - approved Wayne Moore, DG, Strategic and Regulatory Science - approved

Caroline Quinn, Director, Communications - pending
Philippe Morel, ADM, Aquatic Ecosystems - pending
Arran McPherson, ADM, Science - pending
Kathryn McElhone, Acting DG Communications - pending
SADMO
DMO
MINO

From:

Jenkins, Phil

Sent:

January-31-19 8:18 AM

To:

Girouard, Louise; Bate, Dan; Rainer, Michelle; Lowe, Carmel

Cc:

Szerze, Anita: Seguin, Natalie: Ouinn, Caroline

Subject:

RE: No PRV tech brief tomorrow

13:00 ET...yes.

Phil

From: Girouard, Louise

Sent: January-31-19 11:18 AM

To: Jenkins, Phil <Phil.Jenkins@dfo-mpo.gc.ca>; Bate, Dan <Dan.Bate@dfo-mpo.gc.ca>; Rainer, Michelle <Michelle.Rainer@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>

Cc: Szerze, Anita <Anita.Szerze@dfo-mpo.gc.ca>; Seguin, Natalie <Natalie.Seguin@dfo-mpo.gc.ca>;

Quinn, Caroline < Caroline. Quinn@dfo-mpo.gc.ca>

Subject: RE: No PRV tech brief tomorrow

Would 10 BC time work?

From: Jenkins, Phil < Phil.Jenkins@dfo-mpo.gc.ca>

Sent: Thursday, January 31, 2019 8:09 AM

To: Girouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>; Bate, Dan <Dan.Bate@dfo-mpo.gc.ca>; Rainer, Michelle <Michelle.Rainer@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca> Cc: Szerze, Anita <Anita.Szerze@dfo-mpo.gc.ca>; Seguin, Natalie <Natalie.Seguin@dfo-mpo.gc.ca>;

Quinn, Caroline < Caroline.Quinn@dfo-mpo.gc.ca>

Subject: RE: No PRV tech brief tomorrow

Yes, I can brief you...Carmel was also on the call.

Let me know when's a good time to chat.

Phil

From: Girouard, Louise

Sent: January-31-19 11:08 AM

To: Jenkins, Phil < Phil.Jenkins@dfo-mpo.gc.ca>; Bate, Dan < Dan.Bate@dfo-mpo.gc.ca>; Rainer,

Michelle < Michelle.Rainer@dfo-mpo.gc.ca >; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca >

Cc: Szerze, Anita < Anita. Szerze@dfo-mpo.gc.ca >; Seguin, Natalie < Natalie. Seguin@dfo-mpo.gc.ca >;

Quinn, Caroline < Caroline.Quinn@dfo-mpo.gc.ca>

Subject: RE: No PRV tech brief tomorrow

Any sense of how the meeting went?

L

From: Jenkins, Phil < Phil.Jenkins@dfo-mpo.gc.ca >

Sent: Thursday, January 31, 2019 8:05 AM

To: Girouard, Louise <<u>Louise.Girouard@dfo-mpo.gc.ca</u>>; Bate, Dan <<u>Dan.Bate@dfo-mpo.gc.ca</u>>; Rainer, Michelle <<u>Michelle.Rainer@dfo-mpo.gc.ca</u>>; Lowe, Carmel <<u>Carmel.Lowe@dfo-mpo.gc.ca</u>> Co: Szerze, Anita <<u>Anita.Szerze@dfo-mpo.gc.ca</u>>; Seguin, Natalie <<u>Natalie.Seguin@dfo-mpo.gc.ca</u>>;

Quinn, Caroline < <u>Caroline.Quinn@dfo-mpo.gc.ca</u> > Subject: No PRV tech brief tomorrow						
Maybe next week.						
Vill keep you in the loop on any further developments.						
Phil						

From:

Girouard, Louise

Sent:

February-07-19 8:38 AM

To:

Webb, Allison; Lowe, Carmel; Thomson, Andrew; Reid, Rebecca

Cc:

Rainer, Michelle: Antcliffe, Bonnie: Bate, Dan

Subject:

RE: FOR APPROVAL: Draft Media Advisory Technical Briefing PRV carmel

Allison.

The briefing is for accredited media only (DFO officials and MinO can listen in) Perhaps best to discuss with Wayne Moore who is organizing the briefing to discuss how to best deal with stakeholders.

L

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: Thursday, February 7, 2019 8:27 AM

To: Girouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-

mpo.gc.ca>; Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca>; Reid, Rebecca

<Rebecca.Reid@dfo-mpo.gc.ca>

Cc: Rainer, Michelle < Michelle.Rainer@dfo-mpo.gc.ca>; Antcliffe, Bonnie < Bonnie.Antcliffe@dfo-

mpo.gc.ca>; Bate, Dan < Dan.Bate@dfo-mpo.gc.ca>

Subject: Re: FOR APPROVAL: Draft Media Advisory Technical Briefing PRV carmel

Can this be sent to the first Nations fisheries council and the BCSFA?

Sent from my BlackBerry 10 smartphone on the Bell network.

From: Girouard, Louise

Sent: Wednesday, February 6, 2019 3:50 PM

To: Lowe, Carmel; Thomson, Andrew; Reid, Rebecca

Cc: Webb, Allison; Rainer, Michelle; Antcliffe, Bonnie; Bate, Dan

Subject: RE: FOR APPROVAL: Draft Media Advisory Technical Briefing PRV carmel

Carmel & al.

Here is the dial-in information to listen in for tomorrow's tech briefing on PRV

Dial-in number: 1-888-265-0903 or 613-960-7527

Participant passcode:

s.16(2)(c)

Please call into the teleconference 15 minutes prior to start time.

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: Wednesday, February 6, 2019 1:39 PM

To: Girouard, Louise < Louise. Girouard@dfo-mpo.gc.ca>; Thomson, Andrew < Andrew. Thomson@dfo-

mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>

Cc: Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Rainer, Michelle <Michelle.Rainer@dfo-mpo.gc.ca>;

Antcliffe, Bonnie < Bonnie. Antcliffe@dfo-mpo.gc.ca >; Bate, Dan < Dan. Bate@dfo-mpo.gc.ca >

Subject: Re: FOR APPROVAL: Draft Media Advisory Technical Briefing PRV carmel

Thanks Louise.

Will there be any opportunity for region to dial-in as observers?

Carmel

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: Girouard, Louise

Sent: Wednesday, February 6, 2019 07:55

To: Thomson, Andrew; Reid, Rebecca; Lowe, Carmel

Cc: Webb, Allison; Rainer, Michelle; Antcliffe, Bonnie; Bate, Dan

Subject: FOR APPROVAL: Draft Media Advisory Technical Briefing PRV

I am told that MinO wishes to proceed with the media technical briefing on PRV tomorrow morning. Below is the draft MA that is currently with MinO.

Attendees are co-chairs of Peer Review process, DFO Jay Parsons as spokes.

L

Media Advisory

For Immediate Release

Co-chairs of peer review committee to give technical briefing

Vancouver, British Columbia - Co-chairs of a peer-review meeting on the risk to Fraser River sockeye salmon due to possible Piscine Orthoreovirus (PRV) transfer from Atlantic salmon farms, will give a media technical briefing to discuss the peer-review results.

Date: Thursday, February 7, 2019

Time: 9:30 a.m. PST

Phone-in details: Media planning to participate are required to register by calling (613) 990-7537 or emailing media.xncr@dfo-mpo.gc.ca by 9:00 a.m. PST on Friday February 1, 2019.

Registered media are requested to call in 15 minutes prior to the start of the teleconference.

Note: The media availability is for accredited media only.

Louise Girouard

Regional Director Communications | Directrice régionale des communications
Pacific Region | Région du Pacifique
Fisheries, Oceans and Canadian Coast Guard | Pêches, Océans et Garde côtière canadienne
Louise.Girouard@dfo-mpo.gc.ca_Tel: 604.666.3855| Cell:

s.16(2)(c)

From: Girouard, Louise

Sent: February-07-19 8:43 AM

To: Lowe, Carmel; Reid, Rebecca; Antcliffe, Bonnie; Webb, Allison; Thomson, Andrew

Cc: Rainer, Michelle; Bate, Dan

Subject: FW: For MinO Approval | Updated News Release and MLs | PRV Media Briefing

Attachments: NR_PRV_Final_E.docx

Good morning:

The following NR has been approved by MinO for release at 10:30 PT today.

L

News Release

For Immediate Release

Peer Review concludes Piscine Orthoreovirus transfer from Atlantic salmon farms poses minimal risk to wild Fraser River sockeye

February 7, 2019

Vancouver, British Columbia

Fisheries and Oceans Canada

From January 28-30, 2019, Fisheries and Oceans Canada's Canadian Science Advisory Secretariat (CSAS) conducted a meeting to review scientific evidence and to provide science advice on the risk to Fraser River sockeye salmon due to Piscine Orthoreovirus (PRV) transfer from Atlantic salmon farms located in the Discovery Islands area, British Columbia. This peer-review process is a recommendation of the Cohen Commission.

The scientific experts who peer reviewed the data and risk assessment reached a consensus that the risk to Fraser River sockeye salmon due to PRV is minimal. This is consistent with the conclusion of a 2015 CSAS report.

The assessment was conducted based on the latest Canadian and international data including results from the Strategic Salmon Health Initiative.

As there are still some knowledge gaps in our understanding of this virus, Fisheries and Oceans Canada will continue to be vigilant, and support further scientific research on PRV. It will also rely on domestic and international experts in this field, and the peer review process, to obtain the best science available to inform evidence-based decisions on the management and regulation of Canada's aquaculture sector.

The PRV risk assessment represents the sixth in the series of ten risk assessments on pathogen transfer from farmed Atlantic salmon to Fraser River sockeye salmon. The assessment follows the standard CSAS process, which is a robust and transparent peer-review procedure that ensures meeting conclusions and final scientific advice are reached by expert consensus.

A full report on the peer-review findings will be published on the CSAS website in late spring 2019.

Quick Facts

- The peer review meeting was held in Vancouver from January 28-30, 2019
- The 33 peer-review participants, of which 15 were Fisheries and Oceans Canada employees, also included domestic and international experts including from environmental non-governmental organizations, Indigenous groups, academia, the aquaculture industry, the Canadian Food Inspection Agency, and the British Columbia Ministry of Agriculture.

- This risk assessment supports Fisheries and Oceans Canada's role in the management of aquaculture in British
 Columbia and aligns with recommendations in the final report of the Commission of Inquiry into the Decline of Sockeye
 Salmon in the Fraser River, including recommendations 18 and 19 on risks to wild fish populations related to pathogen
 transfers from fish farms and other fish health-related recommendations.
- This is consistent with Fisheries and Oceans Canada's statement of additional measures announced in 2018 to ensure
 the environmental sustainability of finfish aquaculture, including a new study on the alternative technologies for
 aquaculture, moving towards an area-based approach to aquaculture management, developing a framework for
 aquaculture risk management based on the precautionary approach and creating a single comprehensive set of
 regulations: the General Aquaculture Regulations.

Related Products

Understanding the Canadian Science Advisory Secretariat

Associated Links

• Terms of Reference for the PRV review panel

- 30 -

For more information:

Jocelyn Lubczuk Press Secretary Office of the Minister of Fisheries, Oceans and the Canadian Coast Guard

Jocelyn.lubczuk@dfo-mpo.gc.ca

Media Relations
Fisheries and Oceans Canada
613-990-7537
Media.xncr@dfo-mpo.gc.ca

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Follow the Canadian Coast Guard on <u>Twitter</u>, <u>Facebook</u>, <u>Instagram</u> and <u>YouTube</u>.

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From: Jenkins, Phil < Phil.Jenkins@dfo-mpo.gc.ca>

Sent: Thursday, February 7, 2019 8:30 AM

To: Girouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>

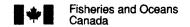
Cc: ComApproval / Approbation (DFO/MPO) < ComApproval/Approbation.XNCR@dfo-mpo.gc.ca>;

Nasrallah, Christine < Christine. Nasrallah@dfo-mpo.gc.ca>

Subject: FW: For MinO Approval | Updated News Release and MLs | PRV Media Briefing

Here you go.

s.16(2)(c)



News Release

For Immediate Release

Peer Review concludes Piscine Orthoreovirus transfer from Atlantic salmon farms poses minimal risk to wild Fraser River sockeye

February 7, 2019

Vancouver, British Columbia

Fisheries and Oceans Canada

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 Ministry of Agriculture.
- This risk assessment supports Fisheries and Oceans Canada's role in the management of aquaculture in British Columbia and aligns with recommendations in the final report of the Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, including recommendations 18 and 19 on risks to wild fish populations related to pathogen transfers from fish farms and other fish health-related recommendations.
- This is consistent with Fisheries and Oceans Canada's statement of additional measures announced in 2018 to ensure the environmental sustainability of finfish aquaculture, including a new study on the alternative technologies for aquaculture, moving towards an area-based approach to aquaculture management, developing a framework for aquaculture risk management based on the precautionary approach and creating a single comprehensive set of regulations: the General Aquaculture Regulations.

Canadä

Related Products

Understanding the Canadian Science Advisory Secretariat

Associated Links

• Terms of Reference for the PRV review panel

- 30 -

For more information:

Jocelyn Lubczuk Press Secretary Office of the Minister of Fisheries, Oceans and the Canadian Coast Guard

Jocelyn.lubczuk@dfo-mpo.gc.ca

Media Relations
Fisheries and Oceans Canada
613-990-7537
Media.xncr@dfo-mpo.gc.ca

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- Follow the Canadian Coast Guard on Twitter, Facebook, Instagram and YouTube.
- Subscribe to receive our news releases and more via RSS feeds. For more information or to subscribe, visit http://www.dfo-mpo.gc.ca/media/rss-eng.htm.

s.16(2)(c)



From:

Girouard, Louise

Sent:

February-07-19 10:16 AM

To:

Webb, Allison; Thomson, Andrew; Rainer, Michelle; ban.bate@dfo-mpo.gc.ca; Lowe, Carmel;

Antcliffe, Bonnie

Subject:

Fw: 911 - FW: CSAS PRV communications

News Release is on hold for reasons below. Louise

From: Jenkins, Phil < Phil.Jenkins@dfo-mpo.gc.ca> **Sent:** Thursday, February 7, 2019 10:12 AM

To: Hill, Johanna; Moore, Wayne; Jarjour, Jasmine; Stringer, Kevin **Cc:** Northcott, Jennifer; Girouard, Louise; Parsons, Jay; Quinn, Caroline

Subject: RE: 911 - FW: CSAS PRV communications

We are holding the NR back pending decision.

Phil

From: Hill, Johanna

Sent: February-07-19 1:07 PM

To: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca>; Jarjour, Jasmine < Jasmine. Jarjour@dfo-

mpo.gc.ca>; Stringer, Kevin < Kevin.Stringer@dfo-mpo.gc.ca>

Cc: Northcott, Jennifer <Jennifer.Northcott@dfo-mpo.gc.ca>; Jenkins, Phil <Phil.Jenkins@dfo-

mpo.gc.ca>; Girouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-

mpo.gc.ca>; Quinn, Caroline < Caroline.Quinn@dfo-mpo.gc.ca>

Subject: RE: 911 - FW: CSAS PRV communications

Sharing now.

From: Moore, Wayne

Sent: Thursday, February 7, 2019 12:59 PM

To: Jarjour, Jasmine <Jasmine.Jarjour@dfo-mpo.gc.ca>; Stringer, Kevin <Kevin.Stringer@dfo-

mpo.qc.ca>

Cc: Northcott, Jennifer <Jennifer.Northcott@dfo-mpo.gc.ca>; Hill, Johanna <Johanna.Hill@dfo-mpo.gc.ca>; Jenkins, Phil <Phil.Jenkins@dfo-mpo.gc.ca>; Girouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>; Cirouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>; Cirouard.gc.ca>; Cirouard.

mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Quinn, Caroline <Caroline.Quinn@dfo-

mpo.gc.ca>

Subject: 911 - FW: CSAS PRV communications

Hi all...could you flag the following to Jocelyn and M-P asap.

Context:

Out of respect for the fact that we were breaking the embargo we had all agreed to observe at the CSAS meeting, we notified participants last night of the upcoming press conference.

We received two responses.

One of our experts who was also on the Nemer Panel on Aquaculture Science saw this as a positive and proactive communication.

The response from one of the ENGO experts is below. (He is with DSF)

I take issue with a couple of his claims.

- 1) We have gone out before all the documents are finalized. This is more common on the east coast on fish stocks but has been used in other contexts recently.
- 2) The participants did leave the room with a consensus agreement on the key conclusions (ie, what we have briefed you on). While there is a final review of the documents, this should not undo the conclusions agreed to at the meeting.
- 3) This is also consistent with Nemer's findings to be more proactive in our comms.
- 4) I would recommend a written response from us to politely declining his request for the reasons above.

Wayne

Wavne Moore

Director General, Strategic and Regulatory Science Fisheries and Oceans Canada / Government of Canada Wayne.Moore@dfo-mpo.qc.ca / Tel: 613-990-0001

Directeur général, Sciences stratégiques et réglementaires Pêches et Océans Canada / Gouvernement du Canada <u>Wayne.Moore@dfo-mpo.gc.ca</u> / Tél. : 613-990-0001

Web: <u>DFO/MPO</u> Twitter: <u>DFO/MPO</u>

From: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Sent: February 7, 2019 12:27 PM

To: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca>

Subject: Fw: CSAS PRV communications

rrom:	
Sent: Thursday, February 7, 2019 12:26 PM	
To: Parsons, Jay	
Cc: Olivier, Gilles; cstephen@cwhc-rcsf.ca ; Burgetz, Ingrid; Waddington, Zac; Struthers	
	Miller-Saunders, Kristi;
espen.rimstad@nmbu.no; niven@vet.dtu.dk; mark.powell@hi.no; iaga	ardner@upei.ca; Garver, Kyle
Polinski, Mark; Weber, Lily; Mimeault, Caroline; Holt, Kendra; Johnson, Stewart; Jones,	Simon;
	tony.farrell@ubc.ca;
Gary.Marty@gov.bc.ca;	Boily, France
	• • • • • • • • • • • • • • • • • • • •

Subject: Re: CSAS PRV communications

Jay,

I'm writing to express our grave concern re. your plans to proceed with an 11am PT media briefing this morning.

2

In terms of our participation in CSAS processes over the last couple of decades, this approach (i.e., briefing media on a process that is incomplete, with 6+ weeks of work remaining) - without providing any sort of documentation for CSAS participants, media, etc. to review in advance - is unprecedented and unacceptable.

We have long been trusted participants in CSAS processes, and this - simply put - is not what we signed up for.

Our recommendation for you at this stage is to cancel today's media briefing. Otherwise, we will be put in an impossible position, and will speak to media about the flaws in this process.

We appreciate the "spirit of transparency" mentioned in your memo, but not at the expense of derailing DFO's primary science-based peer review process.

Thank you for your time and consideration – we await your response.

Best,

On Feb 6, 2019, at 7:07 PM, Parsons, Jay < <u>Jay.Parsons@dfo-mpo.gc.ca</u>> wrote:

Colleagues,

I want to provide a quick update following the PRV CSAS meeting from last week. We are finalizing the other sections of the SAR (Background, Analysis and Other Considerations) and we should be able to distribute this to you for your review by next week.

As well, given the considerable interest on PRV in British Columbia and in the spirit of transparency, there is much interest in having the Department communicate some information on this process. To that end, the Department will issue a News Release tomorrow on the high level findings of the CSAS meeting. The News Release will be a plain language summary of the key findings and it will be consistent with the wording of the agreed-to summary bullets that we developed at the meeting. In addition, there will be a media technical briefing tomorrow by the Cochairs on the key findings of the CSAS meeting (i.e., the summary bullets).

I recognize that as a result of the News Release and the media technical briefing, media may approach some of you with questions on the process and / or findings. If approached by the media, we ask that any discussion on the results of the peer-review be limited to our agreed-on summary bullets, at least until the full SAR is approved by everyone. As a reminder, I have attached the summary bullets as discussed at the meeting.

Please let me know if there are any questions or concerns.

s.19(1)

Jay

Jay Parsons, PhD

Director

Aquaculture, Biotechnology and Aquatic Animal Health Sciences Branch
Fisheries and Oceans Canada / Government of Canada

200 Kent Street, Stn 12E239 Ottawa, ON Canada K1A 0E6 Jay.Parsons@dfo-mpo.gc.ca/ Tel. 613-990-0278

Directeur

Direction des sciences de l'aquaculture, de la biotechnologie et santé des animaux aquatiques Pêches et Océans Canada / Gouvernement du Canada 200 Kent Street, Stn 12E239 Ottawa, ON Canada K1A 0E6 Jay.Parsons@dfo-mpo.gc.ca / Tél. 613-990-0278

<image001.png>

<SUMMARY BULLETS.pdf>

No information has been removed or severed from this page

From:

Moore, Wayne

Sent:

February-21-19 8:20 AM

To:

Lowe, Carmel

Subject:

RE: Min brief - Genome Lab: Recent PRV Court Ruling

Calls in but we are waiting.

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: February 21, 2019 11:14 AM

To: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca>

Subject: Re: Min brief - Genome Lab: Recent PRV Court Ruling

Have you connected with CFIA?

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: Moore, Wayne

Sent: Thursday, February 21, 2019 08:07

To: Lowe, Carmel

Subject: FW: Min brief - Genome Lab: Recent PRV Court Ruling

fyi

From: McPherson, Arran < Arran.McPherson@dfo-mpo.gc.ca>

Sent: February 21, 2019 10:04 AM

To: Campbell, John P. < John.Campbell@dfo-mpo.gc.ca>; Morel, Philippe < Philippe.Morel@dfo-

mpo.gc.ca>; Moore, Wayne <<u>Wayne.Moore@dfo-mpo.gc.ca</u>> **Subject:** Fw: Min brief - Genome Lab: Recent PRV Court Ruling

Fyi.

Sent from my BlackBerry 10 smartphone on the Bell network.

From: Jarjour, Jasmine < Jasmine.Jarjour@dfo-mpo.gc.ca>

Sent: Thursday, February 21, 2019 9:41 AM

To: McPherson, Arran

Subject: FW: Min brief - Genome Lab: Recent PRV Court Ruling

Morning Arran – there were some emails last night on this. Not sure if you were included already. Sending now just for awareness.

From: Proctor, Jody < Jody. Proctor@dfo-mpo.gc.ca >

Sent: February-21-19 9:21 AM

To: Jarjour, Jasmine < <u>Jasmine.Jarjour@dfo-mpo.gc.ca</u>>

Subject: Re: Min brief - Genome Lab: Recent PRV Court Ruling

Sent you the note from this am

But I did get Carmel out of office so can you make sure someone ready? Tx

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Jarjour, Jasmine" < Jasmine.Jarjour@dfo-mpo.gc.ca>

Date: 2019-02-21 9:11 AM (GMT-05:00)

To: "Proctor, Jody" < Jody. Proctor@dfo-mpo.gc.ca>

Subject: RE: Min brief - Genome Lab: Recent PRV Court Ruling

Hi Jody.

Did we land on this? I'm just wondering if I need to give Arran, Phillippe and Rebecca a heads up! Jaz

From: Proctor, Jody < Jody. Proctor@dfo-mpo.gc.ca >

Sent: February-20-19 6:54 PM

To: Hill, Johanna < Johanna. Hill@dfo-mpo.gc.ca >; Robinson, Connor < Connor. Robinson@dfo-

mpo.gc.ca>; Jarjour, Jasmine < Jasmine.Jarjour@dfo-mpo.gc.ca>; Hirani, Samia < Samia.Hirani@dfo-

mpo.gc.ca>; Barker, Tyler < Tyler.Barker@dfo-mpo.gc.ca> Subject: Re: Min brief - Genome Lab: Recent PRV Court Ruling

Thanks for this. I am checking in with Tim but this is new and it might be nice to give department time to react.

Will let you know

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Hill, Johanna" < Johanna. Hill@dfo-mpo.gc.ca>

Date: 2019-02-20 6:34 PM (GMT-05:00)

 $\label{to:proctor_objective} To: "Proctor, Jody" < \underline{Jody.Proctor@dfo-mpo.gc.ca} >, "Robinson, Connor" < \underline{Connor.Robinson@dfo-mpo.gc.ca} >, "Jarjour, Jasmine" < \underline{Jasmine.Jarjour@dfo-mpo.gc.ca} >, "Hirani, Samia" < \underline{Samia.Hirani@dfo-mpo.gc.ca} >, "Barker, "Bar$

Tyler" < Tyler.Barker@dfo-mpo.gc.ca>

Subject: Min brief - Genome Lab: Recent PRV Court Ruling

Hi, all.

Mino has asked to add the email below to the agenda for the Min brief tomorrow.

This is the first I've seen of this email, not sure if any of you have seen it. Mino is asking that it be added as a discussion item only, but I'm not sure if you feel we would be ready to discuss it.

I expect the discussion to take only a few minutes, but I'm also concerned the agenda is getting quite full.

Thanks, and let me know if you think we're ok to proceed on this tomorrow and I'll let Mino know.

Johanna

From: Bob Chamberlin

Sent: Wednesday, February 20, 2019 15:41

To: "Wilkinson, Jonathan - Personal" < Jonathan. Wilkinson. P9@parl.gc.ca>

Subject: Genome Lab: Recent PRV Court Ruling

Good morning Minister Wilkinson

I trust this email finds you well today.

I first want to thank you for your comments in the media recently of wanting to support the work we are pursuing in our LoU work

I am participating in a Fish Farm LoU Meeting this morning and just received an update from DFO concerning access to the DFO Genome facility in Nanaimo

Access to the lab was described as being hinged upon DFO completing an analysis of the recent court ruling concerning PRV testing

There are synergy's to be captured visa via genome testing that DFO will conduct and what we need accomplished for our work

I am getting concerned that your public commitments are being somewhat lost on staff here in the Pacific Region

I have urgency of course of course to have this remedied and keep the discussion internal

Respectfully

Robert (Galagame') Chamberlin Elected Chief Councilor Kwikwasutinuxw Haxwa'mis First Nation

Ema	il:	bobo	@kh	fn.ca
Cel:				

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s.19(1)

From:

Reid. Rebecca

Sent:

February-21-19 12:32 PM

To:

Kaba, Kyle; Hill, Johanna; Simons, Fiona

Cc:

Proctor, Jody; McIntyre, Alexis; Lowe, Carmel

Subject:

Re: Genome Lab: Recent PRV Court Ruling

We are using time to prep for mo call.

RR

Sent from my Samsung Galaxy smartphone.

----- Original message -----

From: "Kaba, Kyle" < Kyle.Kaba@dfo-mpo.gc.ca>

Date: 2019-02-21 12:30 PM (GMT-08:00)

To: "Hill, Johanna" <Johanna. Hill@dfo-mpo.gc.ca>, "Simons, Fiona" <Fiona. Simons@dfo-mpo.gc.ca>, "Reid,

Rebecca" < Rebecca. Reid@dfo-mpo.gc.ca>

Cc: "Proctor, Jody" <Jody. Proctor@dfo-mpo.gc.ca>, "McIntyre, Alexis" <Alexis. McIntyre@dfo-mpo.gc.ca>,

"Lowe, Carmel" < Carmel. Lowe@dfo-mpo.gc.ca >

Subject: RE: Genome Lab: Recent PRV Court Ruling

Can this call be set up for later this afternoon – after 1:15pm PST? Rebecca is in a meeting until then. Let me know!

From: Hill, Johanna < Johanna. Hill@dfo-mpo.gc.ca>

Sent: February-21-19 12:16 PM

To: Simons, Fiona <Fiona.Simons@dfo-mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca> Cc: Kaba, Kyle <Kyle.Kaba@dfo-mpo.gc.ca>; Proctor, Jody <Jody.Proctor@dfo-mpo.gc.ca>; McIntyre, Alexis <Alexis.McIntyre@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>

Subject: RE: Genome Lab: Recent PRV Court Ruling

I set this call up for 3:30 Eastern.

From: Simons, Fiona < Fiona. Simons@dfo-mpo.gc.ca >

Sent: Thursday, February 21, 2019 3:01 PM

To: Reid, Rebecca < Rebecca. Reid@dfo-mpo.gc.ca >

Cc: Kaba, Kyle < Kyle.Kaba@dfo-mpo.gc.ca >; Proctor, Jody < Jody.Proctor@dfo-mpo.gc.ca >; McIntyre, Alexis < Alexis.McIntyre@dfo-mpo.gc.ca >; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca >; Hill, Johanna

<Johanna.Hill@dfo-mpo.gc.ca>

Subject: Re: Genome Lab: Recent PRV Court Ruling

Adding Johanna. When are you available?

Fiona Simons

Pacific Desk

Office of the Minister of Fisheries, Oceans, and the Canadian Coast Guard T: E: Fiona.Simons@dfo-mpo.gc.ca On Feb 21, 2019, at 2:52 PM, Reid, Rebecca < Rebecca. Reid@dfo-mpo.gc.ca> wrote: Carmel and I are available. We will need DMO support to set up a call. RRRebecca Reid Regional Director General/ Directrice générale régionale Fisheries and Oceans Canada - Pacific Region/ Pêches et Océans Canada - Région du Pacifique 200-401 Burrard Street / 401, rue Burrard, bureau 200 Vancouver, BC/CB V6C 3S4 Office / Téléphone: 604-666-6098 Cell / Cellulaire: E-mail/ Courriel: rebecca.reid@dfo-mpo.gc.ca From: Simons, Fiona <Fiona.Simons@dfo-mpo.gc.ca> Sent: Thursday, February 21, 2019 11:42 AM To: Reid. Rebecca < Rebecca. Reid@dfo-mpo.gc.ca> Cc: McIntyre, Alexis < Alexis. McIntyre@dfo-mpo.gc.ca > Subject: Fwd: Genome Lab: Recent PRV Court Ruling Can we discuss today? **Fiona Simons** Pacific Desk Office of the Minister of Fisheries, Oceans, and the Canadian Coast Guard E: Fiona.Simons@dfo-mpo.gc.ca s.16(2)(c) Begin forwarded message: From: "Wilkinson, Jonathan - Personal" < Jonathan. Wilkinson. P9@parl.gc.ca> Date: February 21, 2019 at 2:35:17 PM EST To: Bob Chamberlin <bobc@khfn.ca> Cc: "Simons, Fiona" < fiona.simons@dfo-mpo.gc.ca> Subject: Re: Genome Lab: Recent PRV Court Ruling

Hi Bob

Thanks for you note. I will discuss status with my officials and get back to you.

Jonathan

From: Bob Chamberlin

Sent: Wednesday, February 20, 2019 15:41

To: "Wilkinson, Jonathan - Personal" < Jonathan. Wilkinson. P9@parl.gc.ca>

Subject: Genome Lab: Recent PRV Court Ruling

Good morning Minister Wilkinson

I trust this email finds you well today.

I first want to thank you for your comments in the media recently of wanting to support the work we are pursuing in our LoU work

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Access to the lab was described as being hinged upon DFO completing an analysis of the recent court ruling concerning PRV testing

There are synergy's to be captured visa via genome testing that DFO will conduct and what we need accomplished for our work

I am getting concerned that your public commitments are being somewhat lost on staff here in the Pacific Region

I have urgency of course of course to have this remedied and keep the discussion internal

Respectfully

Robert (Galagame') Chamberlin Elected Chief Councilor Kwikwasutinuxw Haxwa'mis First Nation

Cel:

Email: bobc@khfn.ca

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From:

Webb, Allison

Sent:

February-23-19 8:48 AM

To:

Lowe, Carmel

Subject:

Re: PRV Testing Policy Working Group (John / Alistair / Rod /EOS / Pacifique)

Thanks so much.

I didn't know about or participate in a meeting yesterday.

Have a good wkend,

Allison

Sent from my BlackBerry 10 smartphone on the Bell network.

From: Lowe, Carmel

Sent: Saturday, February 23, 2019 7:50 AM

To: Webb, Allison

Subject: RE: PRV Testing Policy Working Group (John / Alistair / Rod /EOS / Pacifique)

Yes, Rebecca, Andy and I all participated. Not a lot to report back on from my perspective.... The ppt slide timeline was discussed – they are establishing a WG that all 4 of us are on to implement the actions outlines on ppt and we will meet weekly....

BTW - was there a meeting with Kevin yesterday on aquaculture?

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177

Facsimile | Télécopieur 250-729-8360

Government of Canada | Gouvernement du Canada

s.21(1)(a)

s.21(1)(b)

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: February 22, 2019 5:47 PM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Subject: FW: PRV Testing Policy Working Group (John / Alistair / Rod /EOS / Pacifique)

Hi Carmel – Did you attend this meeting or did it even occur? I might need to get a debrief.

Thanks so much, Allison

Allison Webb, Director / Directrice

Aquaculture Management / Gestion de l'aquaculture

Fisheries Management Branch / Direction de la gestion des pêches

Fisheries and Oceans Canada / Pêches et Océans Canada

200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada

604-666-7009 Allison.webb@dfo-mpo.gc.ca

From: Reid, Rebecca < Rebecca. Reid@dfo-mpo.gc.ca>

Sent: Thursday, February 21, 2019 12:31 PM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca >; Morel, Philippe < Philippe.Morel@dfo-mpo.gc.ca >; McPherson, Arran < Arran.McPherson@dfo-mpo.gc.ca >; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca >; Campbell, John P. < John.Campbell@dfo-mpo.gc.ca >; Struthers, Alistair < Alistair.Struthers@dfo-mpo.gc.ca >; Haesevoets, Roderick < Roderick.Haesevoets@dfo-mpo.gc.ca >;

: наеѕечоеть, кодегіск < кодегіск.наеѕечоеть@gto-mpo.gc.ca">: Thomson, Andrew < Andrew.Thomson@dfo-mpo.gc.ca; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca> Subject: Re: PRV Testing Policy Working Group (John / Alistair / Rod /EOS / Pacifique)

We are trying to fix MO overlap.

Sent from my Samsung Galaxy smartphone.

----- Original message -----

From: "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca>

Date: 2019-02-21 12:29 PM (GMT-08:00)

To: "Morel, Philippe" < Philippe.Morel@dfo-mpo.gc.ca>, "McPherson, Arran" < Arran.McPherson@dfo-mpo.gc.ca>, "Moore, Wayne" < Wayne.Moore@dfo-mpo.gc.ca>, "Campbell, John P." < John.Campbell@dfo-mpo.gc.ca>, "Struthers, Alistair" < Alistair.Struthers@dfo-mpo.gc.ca>, "Haesevoets, Roderick"

< Roderick. Haesevoets@dfo-mpo.gc.ca>, "Reid, Rebecca" < Rebecca. Reid@dfo-mpo.gc.ca>, "Thomson, Andrew"

<<u>Andrew.Thomson@dfo-mpo.gc.ca</u>>, "Webb, Allison" <<u>Allison.Webb@dfo-mpo.gc.ca</u>>

Subject: RE: PRV Testing Policy Working Group (John / Alistair / Rod / EOS / Pacifique)

This now conflicts with a MINO briefing on same subject that Rebecca and I have been requested to participate in.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

----Original Appointment----

From: Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca> On Behalf Of Morel, Philippe

Sent: February 21, 2019 12:16 PM

To: Lowe, Carmel

Subject: FW: PRV Testing Policy Working Group (John / Alistair / Rod /EOS / Pacifique) **When:** February 21, 2019 3:30 PM-4:15 PM (UTC-05:00) Eastern Time (US & Canada).

Where: 10S034 + Teleconference

Hi Carmel – can you join this call?

(this is Rebecca)

----Original Appointment----

From: Morel, Philippe

Sent: Monday, February 18, 2019 8:10 AM

To: Morel, Philippe; McPherson, Arran; Moore, Wayne; Campbell, John P.; Struthers, Alistair;

Haesevoets, Roderick; Reid, Rebecca; Thomson, Andrew; Webb, Allison

Subject: PRV Testing Policy Working Group (John / Alistair / Rod /EOS / Pacifique)

When: Thursday, February 21, 2019 3:30 PM-4:15 PM (UTC-05:00) Eastern Time (US & Canada).

Where: 10S034 + Teleconference

See attached documents for the meeting

Feb 18th

Teleconference Info
Dial-in: 1-877-413-4788
Passcode:

Merci Sylvie

s.16(2)(c)

From:

Dickie. Catherine

Sent:

February-25-19 12:17 PM

To:

Lowe, Carmel

Subject:

RESPONSE REQUESTED: Feb 28 PRV Testing Policy Working Group

Will you be available to dial into the call at 11:00 on the 28th? Your calendar has a conflict with "Wild Salmon Policy Cross-Sectoral Planning Meeting"

Catherine Dickie

Executive Assistant to the Regional Director Science, Science Branch Fisheries and Oceans Canada | Government of Canada catherine.dickie@dfo-mpo.gc.ca | Tel: 250-729-8369

Adjointe exécutive à la directrice régionale, Direction des sciences Pêches et Océans Canada | Gouvernement du Canada catherine.dickie@dfo-mpo.gc.ca | Tél: 250-729-8369

From: Okahori, Karen < Karen. Okahori@dfo-mpo.gc.ca>

Sent: February-25-19 10:55 AM

To: Delaney, Paula <Paula.Delaney@dfo-mpo.gc.ca>; Dickie, Catherine <Catherine.Dickie@dfo-

mpo.gc.ca>

Subject: Feb 28 PRV Testing Policy Working Group

Hi Paula and Catherine,

Can I confirm that Allison or Carmel will be on the Feb 28 PRV Testing call (organized by P Morel)? And if not, will they be sending an alternate in their absence?

RDG will be in Langley, Chilliwack and Abbotsford on Feb 28 and will not be able to join. Just wanting to make sure we will having regional representation on the call in her absence.

If you could please let me know.

Thank you.

Karen

From:

Webb, Allison

Sent:

February-28-19 6:05 PM

To: Cc: Lowe, Carmel; Okahori, Karen; Thomson, Andrew Barton, Meagan; Delaney, Paula; Dickie, Catherine

Subject:

RE: Mar 7 PRV Testing Policy Working Group

Me too. Tx.

From: Lowe, Carmel

Sent: February 28, 2019 11:29 AM

To: Okahori, Karen; Webb, Allison; Thomson, Andrew **Cc:** Barton, Meagan; Delaney, Paula; Dickie, Catherine **Subject:** RE: Mar 7 PRV Testing Policy Working Group

I plan to participate.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360

Government of Canada | Gouvernement du Canada

From: Okahori, Karen < Karen. Okahori@dfo-mpo.gc.ca>

Sent: February 28, 2019 11:22 AM

To: Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>;

Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca>

Cc: Barton, Meagan < Meagan.Barton@dfo-mpo.gc.ca>; Delaney, Paula < Paula.Delaney@dfo-

mpo.gc.ca>; Dickie, Catherine < Catherine.Dickie@dfo-mpo.gc.ca>

Subject: Mar 7 PRV Testing Policy Working Group

Allison, Carmel and Andv.

RDG will be in Nechako on Mar 7.

Can either of you join Philippe's call on Mar 7 (I see you are already invited, but wanted to check if you plan to join or intend to send an alternate on your behalf.).

Thanks.

Karen

From:

Dhesi, Kiran

Sent:

March-04-19 10:45 AM

To:

Lowe, Carmel

Subject:

FW: PRV task team - debrief

Carmel,

Looks like you are in Vancouver this day. Will you be dialing in for the PVR call?

Kiran

From: Okahori, Karen

Sent: March-04-19 10:42 AM

To: Barton, Meagan; Dhesi, Kiran; Delaney, Paula

Subject: PRV task team - debrief

Can you let me know if Andy, Carmel or Allison plan to be on this call on Mar 6?

----Original Appointment----

From: Morel, Philippe

Sent: March-04-19 8:43 AM

To: Morel, Philippe; Lowe, Carmel; Krahn, Danielle; Webb, Allison; Reid, Rebecca; Struthers, Alistair; Moore, Wayne; Haesevoets, Roderick; Sharzer, Stephen (DOJ); Thomson, Andrew; Quinn, Caroline;

Nielsen, Ingrid; Campbell, John P.; McPherson, Arran **Subject**: Debrief on PRV Task Team meeting of March 5th

When: March-06-19 12:30 PM-1:30 PM (UTC-05:00) Eastern Time (US & Canada).

Where: 10S034 + Teleconference

March 4th

Agenda from March 5th meeting to follow.

Teleconference Info Dial-in: 1-877-413-4788

Passcode:

s.16(2)(c)

From:

Reid, Rebecca

Sent:

March-04-19 3:52 PM

To:

MacDougall, Lesley; Lowe, Carmel

Subject:

Prv risk assessment

What was the level of risk was used to assess risk of salmon? Jay rich in says it was risk of extirpation. Or was it 2%?

Can you advise?

RR

Sent from my Samsung Galaxy smartphone.

Minister / Ministre (DFO/MPO)

From: Hill, Johanna Sent: March-04-19 5:23 PM To: Minister / Ministre (DFO/MPO) Subject: Fwd: Correspondence from the 'Namgis First Nation re Fisheries and Oceans' Policy not to test for PRV **Attachments:** 'Namgis March 4, 2019 Letter to Minister of Fisheries and Oceans.pdf; ATT00001.htm Categories: Add to Existing Docket Johanna Hill Begin forwarded message: From: "Wilkinson, Jonathan - M.P." < Jonathan. Wilkinson@parl.gc.ca> Date: March 4, 2019 at 5:21:02 PM EST To: "Mitchell, Laura" < Laura. Mitchell @dfo-mpo.gc.ca> Cc: "johanna.hill@dfo-mpo.gc.ca" <johanna.hill@dfo-mpo.gc.ca>, "Simons, Fiona" < Fiona. Simons@dfo-mpo.gc.ca >, "Randi. Anderson@dfo-mpo.gc.ca" < Randi. Anderson@dfompo.gc.ca> Subject: Fw: Correspondence from the 'Namgis First Nation re Fisheries and Oceans' Policy not to test for PRV **FYI** From: Sent: March 4, 2019 2:57 PM To: Min.XNCR@dfo-mpo.gc.ca; Wilkinson, Jonathan - M.P. Cc: Reid, Rebecca: DFO Subject: Correspondence from the 'Namgis First Nation re Fisheries and Oceans' Policy not to test for PRV Dear Minister Wilkinson, Please find attached correspondence from 'Namgis First Nation regarding Fisheries and Oceans Canada's policy not to test for PRV. s.16(2)(c) Kind regards, s.19(1)

Lawyer

); + _______ [

F: +1 (604) 682-7131

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BIO VCARD

MLTAIKINS

WESTERN CANADA'S LAW FIRM

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s.19(1)



March 29, 2019

By Email: min@dfo-mpo.gc.ca

Department of Fisheries and Oceans Canada Justice Building Suite 09 House of Commons Ottawa, ON K1A 0A6

Attention:

The Honourable Minister Jonathan Wilkinson

Minister of Fisheries, Oceans and the Canadian Coast Guard

Dear Minister Wilkinson:

Re:

Fisheries and Oceans Canada's ("DFO") Reconsideration of its Policy not to test for the Piscine Orthoreovirus ("PRV") before authorizing introductions or transfer of fish into the Marine Environment (the "PRV Policy")

On February 4, 2019, the Federal Court quashed DFO's PRV Policy finding it unreasonable and unlawful on four independent grounds (*Morton v. Canada (Fisheries and Oceans)*, 2019 FC 143, "*Morton 2019*"). The Federal Court ordered the Minister of Fisheries, Oceans and the Canadian Coast Guard (the "**Minister**") to reconsider the continuation of the PRV Policy and to take into account the Court's reasons when doing so.

The Crown's Duty to Consult and Accommodate 'Namgis

The Court found that DFO had breached the Crown's duty to consult and accommodate 'Namgis with respect to the PRV Policy.

'Namgis remains deeply concerned that introductions or transfers of smolts infected with PRV into the marine environment may have adverse impacts on our constitutionally protected Aboriginal title and rights. 'Namgis once again reiterates its objection to the continuation of the PRV Policy and the need for DFO to consult and accommodate 'Namgis with respect to that Policy. We wish to begin that consultation as soon as possible.

Deep Consultation is Required

Given the potential impact to 'Namgis' Aboriginal title and rights, the need for immediate consultation at the deep end of the *Haida* spectrum is urgent. As the Court noted, DFO's own preliminary assessment is that 'Namgis has a "strong *prima facia* claim to an aboriginal right to fish for food, social and ceremonial purposes (*Morton v. Canada* (*Fisheries and Oceans*), 2019 FC 143, para. 307). We have enclosed the affidavit of Chief Don Svanvik, affirmed on March 7, 2018, ("Svanvik Affidavit") for more information on our title and rights and the adverse impacts any continued transfers of fish infected with

PRV will have on our constitutionally protected title and rights. As the Svanvik Affidavit describes, 'Namgis relies on all five species of wild Pacific salmon to exercise its Aboriginal title and rights. An assessment of the potential harm to our constitutionally protected title and rights requires an assessment of the risk of harm not just to all five species of wild Pacific salmon, but also to the genetically distinct conservation units within our Territory that we rely to exercise our Aboriginal title and rights.

As the Svanvik Affidavit and the enclosed affidavits of Dr. Martin Krkosek affirmed on March 7, 2018 ("Krkosek Affidavit #1") and on May 14, 2018 ("Krkosek Affidavit #2") illustrate, salmon populations of all five species of wild salmon in our Territory are in serious decline and at risk of extirpation. Dr. Krkosek identifies 41 populations found in our Territory that are vulnerable to additional stressors.

As the Svanvik Affidavit further documents, the dire state or our salmon populations and the decades long decline in salmon escapement from the Nimpkish River have led us to undertake significant stewardship measures. 'Namgis has long recognized the vulnerability of the wild salmon populations in our Territory and have expended considerable time and resources on restoring them. We operate a hatchery on the Nimpkish River aimed at restoring salmon populations in our Territory and for many years have voluntarily curtailed the exercise of our Aboriginal right to fish. Please see the Svanvik Affidavit for further information.

We are extremely concerned that, given the current state of severely depleted wild salmon populations in our Territory, any continuation of the PRV Policy could infringe or sterilize the exercise of our Aboriginal title, our Aboriginal right to fish for food, social and ceremonial purposes and our Aboriginal right to govern the natural resources in our Territory, including conducting stewardship activities.

The impacts of PRV-induced jaundice in Chinook, and PRV-induced Erythrocytic Inclusion Body Syndrome (EIBS) in coho, demonstrate that fish farms stocked with PRV-infected fish are a substantive risk of irreparable harm to our Aboriginal rights and title. The minimal research available on how PRV effects wild sockeye salmon, and the undetermined effects of PRV on pink and chum salmon, mean that introducing millions of PRV-infected Atlantic salmon throughout the areas we exercise our rights presents a substantive risk of irreparable harm to our Aboriginal rights and title.

Mr. Justice Manson, when considering the risk PRV poses to our rights, found that "The risk to the Applicant's ['Namgis'] way of life, culture and traditions in salmon fishing, and the lack of meaningful consultation regarding Transfer Licences that could adversely affect their asserted Aboriginal rights, is particularly compelling with respect to irreparable harm ('Namgis First Nation v. Canada (Fisheries, Oceans and Coast Guard), 2018 FC 334, para. 94).

Given the strength of our claim to an Aboriginal right to fish, the currently dire state of wild Pacific salmon in our Territory, and the potentially irreparable impacts to our rights, deep consultation is necessary to ensure that our constitutionally protected title and rights are not infringed or sterilized.

Process for Consultation

We remain disappointed that, to date, we have not been contacted by any representative of the Crown to consult on the PRV Policy. DFO is obliged to begin consultation early in its decision-making process, before that process has moved too far along (*Musqueam Indian Band v. British Columbia*, 2005 BCCA 128 at para. 95).

We note that Andrew Thomson affirmed in an affidavit filed in *Morton 2019* that the steering committee for the Canadian Science Advisory Secretariat ("CSAS") review of the PRV Policy would include First Nations representatives (*Morton 2019*, para. 196).

A 'Namgis representative on the CSAS steering committee would be consistent with the Crown's duty to consult us. Unfortunately, we were not asked to be part of the steering committee and, to our knowledge, the steering committee did not have any First Nations representatives to provide it with information on the potential adverse impacts to our, or any other First Nation's, constitutionally protected title and rights.

Committee, who in turn recommended	that FNFC referred DFO to its Aquaculture Coordinating . We understand that			
technical expertise, Nation.	We understand that has and is not a representative of the FNFC or any First			
We remind the Minister that neither	nor the FNFC represents 'Namgis for any purpose,			

We remind the Minister that to effect meaningful consultation with 'Namgis, the Minister or his appointed delegate, must engage directly with 'Namgis; we have not appointed any organization or body to represent us in consultation with the Crown on the PRV Policy. We further remind the Minister that consultation must be unique to us and our interests. Our rights, title, interests and current situation cannot be addressed through aggregate consultation designed to impose a policy equally on a diverse group of First Nations (Huu-Ay-Aht First Nation et al v. The Minister of Forests et al, 2005 BCSC 697, para. 116).

The Minister must identify to us any person he has designated to fulfil the duty to consult, or if he will be relying on an regulatory processes or bodies to discharge his duty (*Clyde River (Hamlet) v. Petroleum Geo-Services Inc.*, 2017 SCC 40 at para. 46).

The Minister must have procedural safeguards in place to ensure that natural justice is served during consultation (*Haida Nation v. British Columbia (Minister of Forests)*, 2004 SCC 73 at para. 41), including timely provision of information and a meaningful opportunity to respond to that information so that we can express our interests and concerns (*Mikisew Cree First Nation v. Canada (Minister of Canadian Heritage*), 2005 SCC 69 at para. 64). If the Crown does not ensure that procedural safeguards (such as adequate capacity funding, accessible information, responses to requests for information) are in place, then consultation may be significantly impaired and inadequate (*Clyde River (Hamlet*) v. *Petroleum Geo-Services Inc.*, 2017 SCC 40 at paras. 48 and 49).

The Minister must do more than simply provide a process for exchanging information. He must, in good faith, attempt to understand our concerns and move to address them in a manner consistent with the ultimate goal of reconciliation (*Wii'litswx v. British Columbia (Minister of Forests)*, 2008 BCSC 1139 at para. 178). He must also engage the information we provide and be willing to make changes based on that information (*Taku River Tlingit First Nation v. British Columbia (Project Assessment Director)*, 2004 SCC 74 at para. 29; *Haida* at para. 46).

We are extremely concerned that, to date, the Minister has not begun consultation or demonstrated any effort to hear, let alone understand or address, our concerns.

Additionally, and importantly, as the duty to consult 'Namgis is engaged with respect to any reconsideration of the PRV Policy, the Minister must consider the potential impacts any policy regarding PRV could have to our constitutionally protected title and rights themselves, separate and distinct from environmental impacts that might be caused by any policy with respect to PRV. Such an assessment must consider our specific situation, including the current status of populations of wild salmon in our Territory and our ability to continue to exercise our rights. Any failure to assess potential impacts to our rights will result in consultation being inadequate (Clyde River (Hamlet) v. Petroleum Geo -Services Inc., 2017 SCC 40 at para. 45).

We emphasize that the determination of potential adverse impacts to our constitutionally protected title and rights is an entirely separate legal question than the Minister's duty to protect and conserve fish or his duty to adhere to the precautionary principle. We further emphasize that the threshold for when potential adverse impacts to our rights could constitute an infringement, or an extinguishment of our rights, or trigger the duty to accommodate, may be entirely different thresholds than the threshold for when the Minister is prohibited from authorizing introductions or transfers of fish because such transfers may be harmful to the protection of conservation of fish or because they do not adhere to the precautionary principle.

We provide this letter and its enclosures so that the Minister can begin to understand our concerns regarding the PRV Policy and the potential impact on our Aboriginal title and rights. The Minister has a duty to ensure our submissions are seriously considered and integrated into any consideration of the PRV Policy (Mikisew Cree First Nation v. Canada (Minister of Canadian Heritage), 2005 SCC 69 at para. 64) and provide written reasons showing how our submissions were considered and the impact they had on the decision-making process (Chippewas of the Thames First Nation v. Enbridge Pipelines Inc., 2017 SCC 41 at para. 47).

We also provide the information in this letter and its enclosures so that the Minister's delegate will have this letter and its enclosures before him or her when when reconsidering the PRV Policy and so it will form part of the Certified Tribunal Record for such a decision (see *Morton 2019* at paras. 98 to 99).

Any failure to consider the contents of this letter, and its enclosures, respond to our questions and information requests will constitute a breach of the duty to consult. Further any failure to provide written reasons explaining how our submissions impacted the Minister's reconsideration of the PRV Policy, will constitute a breach of the duty to consult and a breach of natural justice and administrative fairness.

Questions:

- When will the Minister begin to consult with 'Namgis on the PRV Policy?
- How will the consultation process ensure that our engagement is not delayed until the process is too far along for our input to be meaningfully considered?
- What terms of reference where provided for the CSAS steering committee?
- How were members of the steering committee selected?
- How was engaged to be a member of the steering committee?
 - O Who did represent on the steering committee?
 - What was the scope of participation in the steering committee?
 - o Did provide scientific expertise?
 - Did provide the steering committee with any traditional knowledge related to any First Nations' Aboriginal title and/or rights or how the continuation of the PRV Policy may affect those rights?
 - O Did provide the steering committee with any information about how First Nations, or 'Namgis, exercise their constitutionally protected rights?
 - Did _____ provide the steering committee any information on how those rights could be adversely impacted or accommodated?
- Were any coastal First Nations contacted for participation in the steering committee or the CSAS review process?
- Why was ______not appointed as a member of the steering committee despite 'Namgis, other First Nations and members of the steering committee suggesting that she be included?
- How will the Minister's delegate for the PRV Policy consider the work of the CSAS process?
- How will 'Namgis be able to present its views on the CSAS panel's findings?
- How will the Minister's delegate consult with 'Namgis?
- Given the potential risk that PRV poses to 'Namgis' constitutionally protected rights and title, how does DFO plan to take precautionary measures to ensure the severely depleted stocks are not reduced to a level that it is not possible to exercise our rights in a meaningful way?

Information Requests:

- Please provide us with:
 - the terms of reference for the CSAS steering committee;
 - the names and qualifications of the members of the CSAS and how they were selected;

- o any minutes, notes or records of meetings of the steering committee;
- o any reports or recommendations produced by the CSAS process;
- o any information the CSAS process was provided on our constitutionally protected rights and title, including who provided that information and when it was provided;
- o any information on how adverse impacts on our constitutionally protected rights and title could be accommodated;
- timelines for the CSAS review and the consideration by the Minister's delegate of the PRV Policy;
- o information on how we can make submissions on the PRV Policy;
- the names of persons who will be consulting with us on the PRV Policy;
- o information on any resources the Crown will provide to ensure that consultation is adequate; and
- o any other information the Minister may have about how the PRV Policy will be reconsidered and how 'Namgis will be consulted on the PRV Policy.

The Court's Findings with Respect to the PRV Policy

The Correct Interpretation of s. 56 of the Fishery (General) Regulations (the "FGRs")

In Morton 2019, the Court found that the Minister's interpretation of s. 56 of the FGRs was inconsistent with the Minister's primary obligation under the Fisheries Act (para. 147) and in effect defeated the actual purpose of the Wild Salmon Policy's definition of conservation by requiring an inappropriate magnitude of harm before transfers of fish were prohibited (para. 146). It also concluded that conservation means more than the protection of stocks from extinction and includes enhancement for the future benefit of all user groups. The Court found that the Minister's interpretation of s. 56 may also conflict with his obligation to protect fish (para. 142).

The Court also noted that the Minister had not addressed what was meant by "protection" in the phrase "may cause harm to the protection and conservation of fish" (para. 142). Clearly, when taking the reasons of the Court into consideration when re-evaluating the PRV Policy, the Minister's delegate must develop an interpretation of s. 56(b) that is consistent with the case law that has interpreted the "conservation and protection of fish", including the enhancement of fish for all user groups such as First Nations.

The Court also noted that the Minister's interpretation of s. 56(b) was likely inconsistent with ss. 56(a) and (c) (para. 141). When considering the impacts of approving transfers of fish with a virus, such as PRV, the Minister must also consider the restraints imposed on his discretion by ss. 56(a) and 56(b) (para. 136).

The Court concluded that the threshold for harm that the Minister identified as prohibiting transfers and introductions, allowed a magnitude of harm that was inconsistent with s. 56(b). The Court noted that a harm that severely impacts fisheries is prohibited by s. 56(b) and that impacts at the conservation unit or populations are a severe potential impact (para. 140). Consequently, the threshold the Minister's delegate can set for when fish can be introduced or transferred under s. 56 is less than a severe impact, less than potential harm to a conservation unit and less than potential harm to a population of fish.

Questions:

- What is the Minister's interpretation of "protection" of fish with respect to s. 56(b) of the FGRs?
- Given that conservation means more than the protection of fish from extinction, and includes the enhancement of stocks, what is the Minister's interpretation of "conservation" with respect to s. 56(b) of the FGRs?
- How will the Minister interpret conservation so that any application of s. 56(b) of the FGRs does
 not conflict without our constitutionally protected right to fish and our enhancement and
 stewardship activities aimed at protecting that right?
- What is the Minister's current interpretation of "conservation and protection of fish"?
- What information will the Minister's delegate consider to determine if introducing fish infected with PRV is in keeping with s. 56(a) of the FGRs? What factors will the Minister's delegate consider when making a decision with respect to s. 56(a)?
- What information will the Minister's delegate consider to determine if introducing fish infected with PRV is in keeping with s. 56(c) of the FGRs?
 - What information does the Minister's delegate have regarding how PRV may affect the stock size or genetic diversity of fish?
 - o How has the Minister's delegate determined that PRV will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks?
- Given that a potential impact to a conservation unit or a population of fish is a severe impact
 that is prohibited by s. 56(b), what aggregate of fish will the Minister's delegate use to
 determine if a disease or disease agent may be harmful to the protection and conservation of
 fish?
- How will the Minister's delegate determine what magnitude of harm to that aggregate may be harmful to the protection and conservation of fish?
- When setting a threshold for potential harm to the protection and conservation of fish, how will the Minister's delegate consider potential adverse impacts to our Aboriginal title and rights?
- What is the view of the Minister's delegate on the magnitude of harm that may be required
 from transfers and introductions of PRV-infected smolts into our Territory to infringe or sterilize
 our constitutionally protected Aboriginal title and rights? How is that level of harm related to
 the level of potential harm that is prohibited under s. 56?

Information Requests:

- Please provide us any information that DFO has that may be used to inform the Minister's decision on what an appropriate aggregate of fish is to determine the risk of potential harm.
- Please provide us any information that DFO has that may be used to determine what is an
 acceptable risk of harm to the protection and conservation of fish.
- Please provide us any information that DFO has that may be used to determine what is an
 acceptable level of risk to the fish that we rely on to exercise our Aboriginal title and rights as
 well as the potential impact to those rights and title themselves.

The Precautionary Principle

In Morton 2019, the Court confirmed once again that s. 56 of the FGRs embodies the precautionary principle (para. 159) and that the Minister must adhere to the precautionary principle, not merely consider it (para. 167). The Court also found that science aimed at mitigating the effects of unlawful threshold cannot cure an unreasonably high risk thresholds that does not adhere to the precautionary principle (paras. 165 and 166). The Court rejected the argument that the precautionary principle is only aimed at protecting against serious or irreversible harm and that protecting against threats that may cause a lower level of harm are contrary to that focus (para. 168).

Instead, the Court clarified that a level of serious or irreversible harm is not required to trigger the precautionary principle, and that "its focus is to exercise more caution when information is uncertain and, where appropriate, to ensure that steps are taken to prevent irreversible harm, even when the potential risk of causing that harm is uncertain" (underlining added, para. 168). The Court went on to note that when the risk is sufficiently serious in nature, precaution may be required where that risk is suspected, conjectured or feared (para. 169).

The Court also noted several acknowledgements by Canada with respect to the precautionary principle:

- the need to be more cautious when information is uncertain, unreliable or inadequate (para. 160);
- a reversal of the burden of proof with respect to harm and the need for longer term outlooks (para. 160);
- decision-making should reflect society's level of risk (para. 160); and
- the need for a high degree of transparency, clear accountability, and meaningful public involvement (para. 160).

The Court noted that DFO had not clarified how it would implement the precautionary principle in the management of aquaculture (para. 162) and observed that the Auditor General had recommended that DFO determine and communicate how it would apply the precautionary principle in aquaculture management and "clearly articulate the level of risk to wild fish that it will accept when enabling the aquaculture industry" (para. 162).

The Court also found that the scientific debate and disagreement on PRV establishes that extra care is required in decision-making concerning PRV (para. 262).

Against this background, the Court found that the Minister derogated from the precautionary principle by ascribing a threshold for harm that did not adhere to the precautionary principle and found that the PRV Policy was unreasonable. The Court also found that decisions relying on the PRV Policy also derogate from the precautionary principle (para. 165).

Given the Minister's failure to adhere to the precautionary principle, despite a 2015 decision of the Federal Court clearly invalidating licence conditions for failing to adhere to the precautionary principle as embodied in s. 56 of the FGRs (paras. 156 to 158), 'Namgis remains extremely concerned that the Minister, or his delegate, will once again fail to adhere to the precautionary principle when reconsidering the PRV Policy.

A credible body of scientific evidence establishes PRV poses a risk of serious or irreversible harm to any or all five species of wild Pacific salmon we rely on to exercise our Aboriginal title and rights. Further, the Minister cannot hide behind any uncertainty within that science, about the magnitude of harm or the likelihood of that harm materializing, to avoid implementing precautionary measures to anticipate, prevent and attack that risk to wild Pacific salmon or our Aboriginal title and rights.

Questions:

- How will the Minister's delegate ensure that any future policy on PRV adheres to, not just considers, the precautionary principle?
- How will the Minister's delegate ensure that any threshold set by DFO that triggers
 precautionary measures does not rely on science to mitigate any deficiencies that threshold
 might have?
- How will the Minister's delegate ensure that more caution is exercised in the face of scientific uncertainty?
- Given the serious nature that PRV poses to wild Pacific salmon how will the Minister's delegate address the Court's statement that precaution may be required when the risk is suspected, conjectured or feared?
- Given the multiple uncertainties regarding PRV, how will the Minister's delegate ensure that greater caution is exercised?
- How will the Minister's delegate address the reversal of the burden of proof required by the
 precautionary principle? How will the Minister's delegate address that reversed burden of proof
 with respect to our Aboriginal title and rights?

- How will the Minister's delegate ensure that any decision with respect to PRV reflects society's chosen level of risk?
- How will the Minister's delegate ensure that the process for re-considering the PRV policy will have a high degree of transparency, clear accountability and meaningful public involvement?
- How and when will the Minister or his delegate determine how DFO will apply the precautionary principle in the context of aquaculture? How will 'Namgis be consulted on that determination?
 - How and when will the Minister articulate the level of risk DFO will accept to wild fish from the
 aquaculture industry? How will that determination affect our constitutionally protected title
 and rights? How will 'Namgis be consulted on that determination?
 - Given the scientific debate regarding PRV, what steps will the Minister's delegate take to ensure that extra care is taken in the decision-making process?

- Please provide us with information on any procedural safeguards are in place to ensure extra care is taken in the decision-making process.
- Please provide us with information on how DFO will apply the precautionary principle in the aquaculture industry.
- Please provide us with the Minister's determination on society's chosen level of risk.
- Please provide us with information on how the Minister will consult with 'Namgis and other First Nations on their chosen level of risk for aquaculture in their territories.

Consideration of Wild Salmon and Other Marine Resources

The Court found that the Minister failed to consider the current health and status of wild Pacific salmon in the context of the prevailing scientific uncertainties surrounding PRV (para. 213). The Court also found that given the high degree of scientific uncertainty surrounding PRV, the rapidly evolving science, DFO's outstanding risk assessment, and the known decline in wild salmon populations, the Minister's delegate failed to address wild Pacific salmon health and status and thus failed to adhere to the precautionary principle (para. 214).

The Court took care to quote from Mr. Justice Rennie's 2015 decision which referred to Mr. Justice Cohen's conclusion that fish farms pose a risk to wild Pacific salmon and that "ensuring the health of wild stocks should be 'DFO's number one priority in conducting fish health work'" (para. 187). Two Federal Court judges have now specifically directed the Minister to note that the health of wild Pacific salmon should be DFO's top priority when considering how to manage the risk associated with PRV.

The Court drew attention to the Auditor General's conclusions that DFO did not manage risk associated with aquaculture consistent with its mandate to protect fish and did not adequately enforce compliance with regulations designed to protect wild fish (para. 192).

Against this backdrop, the Court observed that the Committee of the Status of Endangered Wildlife in Canada ("COSEWIC") estimated that 2016 had the lowest recorded return of sockeye to the Fraser River (para. 191). The Court further observed the COSEWIC evaluated eight populations of Fraser River sockeye as endangered, two as threatened and five as special concern (para. 191). The Court noted that 11 conservation units of Chinook salmon were red-listed, or in danger of extirpation, and seven Fraser River conservation units were also red-listed (para. 189).

The Court further noted that the record previously used to confirm the PRV Policy contained no information concerning the monitoring of wild salmon health or numbers (para. 200). The Court also noted that the previous record did not acknowledge that some conservation units of wild Pacific salmon are at risk or whether or not wild Pacific salmon were at higher risk of PRV infection because of the different environment and stressors they face compared to farmed fish (para. 200).

The Court also found that DFO did not address how conditions faced by wild Pacific salmon might exacerbate the risk of PRV to at-risk conservation units (para. 205). Nor did DFO address what impact the prevalence of heart lesions found in farmed salmon would have on wild salmon populations if the same prevalence of lesions were to occur in wild populations (paras. 205 and 207).

The Court noted that the Pathways of Effects for Aquaculture document stated that understanding the potential of a pathogen to cause infection requires an understanding of "the importance of the modulating factors, including concerning the host (species (stock, age), immunity, stress, density, nutrition, health status (e.g. co-infection); pathogens (strain (pathogenicity, virulence, infectivity), concentration, dose, bioavailability); and, environmental factors (temperature, salinity, water quality, contamination, currents, intermediate hosts and carriers) for that particular pathogen" (para. 195).

The Court observed that DFO failed to address how research had indicated that laboratory results on the effects of PRV may differ from studies of PRV's effects on wild salmon (paras 208 and 209). The Court admonished DFO for not revisiting and reassessing the risk raised by Di Cicco (2018), with its own chosen methods, to confirm that the risk that paper raised was not sufficient to change the PRV Policy (para. 211).

Instead, despite acknowledging that "there may be factors that could potentially cause PRV and HMSI to affect wild Pacific salmon differently than farmed salmon, or at the very least indicate considerable uncertainly in this regard, the Delegate did not engage with the evidence or the issue, instead relying on the Garver 2016(a) and 2016 challenges and the current evidence that HSMI causes very low mortality to Atlantic salmon on BC fish farms to conclude that transfers of fish with low potential to cause mortality do not harm the protection and conservation of fish at a population level and, therefore, can be authorized as per the Minister's Interpretation of s 56(b) of the FGRs" (para. 212).

Against this backdrop of known declines in wild salmon populations and the factors that may be required to assess the risk PRV poses to wild Pacific salmon, the record used to previously affirm the PRV Policy "contain[ed] virtually no information as to the status or health of wild Pacific salmon in British Columbia or how this may, or may not, have factored into the decision to continue the PRV Policy. Moreover, potential impacts on wild salmon are addressed almost exclusively in the context of the effects of PRV and HSMI on farmed salmon" (para. 199).

The Court noted a number of information gaps and scientific uncertainties with respect to the impact PRV may have on wild Pacific salmon:

- Nine conservations units of Chinook salmon were data deficient for evaluation under the Wild Salmon Policy (para. 189).
- Eleven conservations units of Chinook salmon had not been evaluated under the Wild Salmon Policy (para. 189).
- DFO had not made sufficient progress in completing risk assessments that were required to understand the effects of aquaculture on wild fish (para. 192).
- Despite DFO's identification of potential stressors from aquaculture on wild fish had provided only short-term funding for this research and data gaps existed on this issue (para. 193).
- The Auditor General's report concluded the DFO was not monitoring wild fish (para. 193).
- DFO had not completed nine risk assessments of key diseases that it committed to complete by 2020 to evaluate the consequences of disease transfer from aquaculture to wild fish (para. 193).
- Pathogen surveillance of wild populations of salmon is non-existent and without this knowledge, the extent to which pathogens are stressors cannot be assessed (para. 194).
- PRV's role in the development of diseases is uncertain, including how different strains of PRV may cause disease and species susceptibility in fish (para. 202).
- PRV infection may result in altered disease scenarios and conditional requirements may be required for PRV infection to cause disease (para. 204).
- Further studies are required to assess the risk of disease in Pacific salmon and/or the risk of transmission of the virus between wild salmon and farmed salmon (para. 205).
- Three species of wild Pacific salmon have not be subject to challenge trials (para. 206).
- Experimental laboratory results may differ from studies of wild salmon and may not accurately predict disease outcomes in wild populations (paras. 208 and 209).
- The severity and extent of the risk of PRV transmission from farmed to wild salmon remains undetermined (para. 210).

Given the numerous data gaps, scientific uncertainties and previous failures by DFO to assess the risk PRV poses to wild Pacific salmon, we remain extremely concerned that the Minister's delegate will not adequately assess the risk PRV poses to wild Pacific salmon or to our Aboriginal title and rights.

Questions:

How will the Minister's delegate consider the potential impacts of PRV to wild salmon in the context of the current health and status of wild salmon and the prevailing scientific uncertainties surrounding PRV?

- Will DFO complete the outstanding risk assessments so that the Minster's delegate may benefit from them when reconsidering the PRV Policy?
- How will the Minister's delegate address any data gaps and uncertainties created by incomplete risk assessments when reconsidering the PRV Policy?
- How will the Minister's delegate ensure that the health of wild Pacific salmon is DFO's top priority when managing the risk associated with PRV?
- How will the Minister's delegate address how the risk of PRV to wild Pacific salmon may be compounded by DFO's failure to enforce compliance with aquaculture regulations designed to protect wild fish?
- How will the Minister's delegate determine if wild Pacific salmon may be at greater risk from PRV infection than farmed Atlantic salmon because of differences in environment and/or physiology?
- How will the Minister's delegate consider all of the modulating factors, identified by the Pathways of Effects for Aquaculture, that may affect wild Pacific salmon when reconsidering the PRV Policy?
- Will the Minister's delegate continue to rely almost exclusively on laboratory studies despite the
 fact that those studies may produce different outcomes that studies conducted on wild Pacific
 salmon? How will the Minister's delegate account for this difference and potential uncertainty
 when reconsidering the PRV Policy?
- How will the Minister's delegate consider the potential impact of PRV to the 41 populations of wild Pacific salmon in our Territory that are vulnerable to additional stressors and could suffer adverse impacts from PRV?
- How will the Minister's delegate consider the impacts PRV could cause to the genetic diversity and stock size of the 41 vulnerable populations of wild Pacific salmon in our Territory?
- How will the Minister's delegate address how conditions faced by wild Pacific salmon could exacerbate the potential harm to at-risk populations of wild Pacific salmon?
- How will the Minister's delegate evaluate how the prevalence of infection, lesions and disease on fish farms could affect wild Pacific salmon if similar levels of infection, lesions and disease were to occur in populations of wild Pacific salmon?
- How will the Minister's delegate address the risk PRV poses to the nine conservations units of Chinook salmon were data deficient for evaluation under the Wild Salmon Policy (para. 189)?
- How will the Minister's delegate address the risk PRV poses to the eleven conservations units of Chinook salmon had not been evaluated under the Wild Salmon Policy (para. 189)?
- How will the Minister's delegate address the risk PRV poses in the context of DFO's failure to complete risk assessments that were required to understand the effects of aquaculture on wild fish (para. 192)?
- How will the Minister's delegate address the risk PRV poses to wild Pacific salmon when DFO is not monitoring wild fish? What baseline data will DFO use to assess the current health and status of wild Pacific salmon?

- Since pathogen surveillance of wild populations of salmon is non-existent and without this knowledge, the extent to which pathogens are stressors cannot be assessed, how will the Minister's delegate address this scientific uncertainty when reconsidering the PRV Policy?
- How will the Minister's delegate address the uncertainty regarding PRV's role in the development of diseases, including how different strains of PRV may cause disease and species susceptibility in fish?
- How will the Minister's delegate address the uncertainty with respect to the potential for PRV infection to result in altered disease scenarios and conditional requirements may be required for PRV infection to cause disease?
- What further studies has DFO conducted or relied on to assess the risk of disease in Pacific salmon and/or the risk of transmission of the virus between wild salmon and farmed salmon?
 What further studies are required?
- Will all five species of wild Pacific salmon have been subject to challenge trials before the Minister's delegate reconsiders the PRV Policy? If not, how will this data gap be accounted for?
- Given that the severity and extent of the risk of PRV transmission from farmed to wild salmon remains undetermined, how will the Minister's delegate account for this key uncertainty?

- Please provide us with the fish pathogen and disease characterization working paper from the CSAS review process.
- Please provide us with the risk assessment produced by the CSAS process.
- Please provide us with Science Advisory Report from the CSAS process summarizing the science advice for DFO's Aquaculture Management Division.

DFO's Previous Reliance on Demonstrably False Representations to Affirm the PRV Policy

We are extremely concerned that in previous affirmations of the PRV Policy, the decision-maker relied on materials prepared by DFO staff that expressly departed from scientific consensus or misrepresented the findings of scientific papers. We remain extremely concerned that the Minister's delegate may continue to rely on that inaccurate information. We are also extremely concerned that the DFO staff may again place inaccurate information before the Minister's delegate which may affect the outcome of the reconsideration of the PRV Policy and the integrity of the process used to effect that reconsideration.

We have appended to this letter as Schedule "A" a table listing those departures and misrepresentations. We provide this list to inform the current reconsideration of the PRV Policy and in the hope that DFO will not continue to rely on them. We emphasize that this table is not a list of scientific uncertainties, but examples of times when DFO staff are unequivocally misrepresenting scientific findings to DFO decision-makers.

In the table included in Schedule "A", we have listed questions for which we await your responses. Your responses are required so we can form our view of your understanding of the science on PRV and its potential to adversely impact our rights.

Information in DFO's Possession Previously Not Placed before the Minister's Delegate

'Namgis is extremely concerned that evidence of the risk of harm PRV poses to wild Pacific salmon was not placed for the Minister's delegate in previous affirmations of the PRV Policy.

DFO staff have commissioned at least three studies that showed PRV may cause harm to wild Pacific salmon, but did not place the results of those studies before the decision-maker:

- 1. Dr. Kristi Miller's 2011 research showing a link between PRV and jaundice in Chinook salmon.
- 2. Dr. Miller's 2013 research showing that HSMI, now proven to be caused by PRV, was present on BC fish farms.
- 3. Dr. Rimstad's 2015–2016 research, conducted in Norway, which exposed salmon to PRV from BC.

Dr. Miller's 2011 Research Showing a Link between PRV and Fatal Disease in Chinook

Documents disclosed under the *Access to Information Act* (ATIP-2017-01222/DSP, the "01222-ATIP Release") demonstrate that industry, DFO, and the Animal Health Centre at the BC Ministry of Agriculture ("AHC") engaged in an endless pattern of delay and unnecessary revisions to ensure that the Aquaculture Collaborative Research and Development Program ("ACRDP") research on PRV and jaundice was never published.¹

We have enclosed the ATIP-2017-01222/DSP for the consideration of the Minister's delegate when reconsidering the PRV Policy.

DFO, AHC and Creative Salmon prevented Dr. Miller from publishing the ACRDP research conducted in 2011 that associated PRV with jaundice in Chinook salmon at one of Creative Salmon's fish farms. Subsequent research by Dr. Miller's team, published as Di Cicco (2018), demonstrated that PRV likely causes the red blood cells of Chinook to rupture en masse. The rupturing of these red blood cells causes lesions in the liver and kidneys; the fish turn yellow and then die. Dr. Miller's team likely knew of this risk as early as 2011, when their research began, or 2013 when that research was ready for publication.

The 01222-ATIP Release shows Dr. Miller repeatedly, and often very emphatically, apprising her superiors, including Jay Parsons, Nathan Taylor, and Andrew Thomson, that her research related to PRV was being suppressed:

 On November 7, 2017, Dr. Miller emailed Nathan Taylor and described how her research was being suppressed using the same delay tactics that were used in 2013 and earlier. She explained that her team had already spent three years preparing this study for publication. Dr. Miller

¹ Please see draft DFO document called "Aquaculture and Disease Related Research (Pacific Research)," dated July 29, 2016, that says Dr. Miller's research was suppressed because "the histopathologist from the province convinced industry not to sign off on the report (after many iterations) if PRV was to be included in the analysis". ATIP A-2016-01097, page 59.

² E. Di Cicco, H.W. Ferguson, K.H. Kaukinen, A.D. Schulze, S. Li, A. Tabata, O.P. Günther, G. Mordecai, C.A. Suttle, and K.M. Miller (2018), FACETS 3: 599–641.doi:10.1139/facets-2018-0008. The same strain of Piscine orthoreovirus (PRV-1) is involved in the development of different, but related, diseases in Atlantic and Pacific salmon in British Columbia.

- noted that her research was not a priority because it did not address financial hardship to the aquaculture industry (pages 56 and 57).
- On November 8, 2017, Dr. Miller emailed Andrew Thomson, forwarding Creative Salmon's response to her previous email. The response provided no suggested solutions and confirmed the co-authors would not sign off on the publication. Dr. Miller informed Mr. Thomson that the updated manuscript had been forwarded to industry more than a month earlier and that she needed this issue resolved (page 131).
- On November 11, 2017, Dr. Miller emailed Cory Jackson, attaching the manuscript from the ACRDP / Creative Salmon research and explained that she planned to publish a short communication regarding these findings in the next month or so (page 139). To our knowledge, no public communication ever took place.
- On November 15, 2017, Dr. Miller emailed Jay Parsons, copying Nathan Taylor. She attached a
 draft manuscript of her ACRDP research. Dr. Miller informed Mr. Parsons and Mr. Taylor that it
 had been six years since their initial discovery of an association between PRV and jaundice
 and since that time three papers published in other countries had associated PRV with disease
 in Pacific salmon, including proof that PRV causes disease in coho in Japan (page 199).
- On November 16, 2017, Dr. Miller emailed Nathan Taylor, attaching a 2013 report from the ACRDP research on Creative Salmon's Chinook salmon. Dr. Miller explained that by 2013 there had already been a year of haggling over this report and that Creative Salmon did not want the inclusion of PRV in the research report because PRV was not relevant (page 261). Creative Salmon's claim that PRV was irrelevant to the research directly contradicted the project's stated purpose: to determine if jaundice in Chinook is caused by a virus or an environmental factor (see pages 266, 297, and 1629). The email Dr. Miller forwarded with her email to Mr. Taylor described in detail the painstaking efforts Dr. Miller had already taken to placate the concerns of Creative Salmon and AHC.
- On November 16, 2017, Dr. Miller emailed Nathan Taylor, forwarding an email chain from July 2013. In the email chain, Jay Parsons supported publishing the ACRDP research. Dr. Miller said she was done with revisions and that this research needed to move to publication (page 300).
- A summary of the ACRDP research provided by Jay Parsons explained that the research was never published because part of the team believed that the research established a direct and conclusive link between PRV and jaundice, while others believed the link may not be conclusive and other factors may play a role (page 1663).

It is profoundly disturbing that industry and a provincial agency whose mandate is to promote the business interests of aquaculture have been able to silence DFO scientists.

The suppressed paper was the first detection of PRV in North America and the first to associate PRV with jaundice,³ but between 2011, when that detection occurred, and 2017, researchers in other countries published three papers associating PRV with a similar disease in coho (called EIBS) (see page 199).

A draft of Dr. Miller's ACRDP research has been withheld from the 01222-ATIP Release.⁴ But clearly, that draft research was widely circulated, summarized, and known within DFO (pages 131, 139, 199, 261, 297, 1625, 1663, and 1861).⁵ DFO staff cannot rely on the research being unpublished to avoid its duty to apply the precautionary principle in the face of evidence of a real threat of environmental degradation. DFO must take steps to prevent the spread of PRV to wild salmon based on that evidence. Nor can DFO staff use a disagreement within the research team to avoid taking action; using scientific uncertainty to excuse regulatory inaction is contrary to the precautionary principle. Nor can DFO ignore information it has in its possession about how PRV may affect populations of wild salmon that we rely on to exercise our constitutionally protected rights simply because that information has not been published.

Exclusion of Contrary Evidence from the Decision-Making Process

The 01222-ATIP Release shows that DFO had a wealth of internal research confirming PRV is harmful to wild salmon that never made it into the documents put before Dr. Carmel Lowe when she previously affirmed the PRV Policy:

- The Strategic Salmon Health Initiative ("SSHI") found that of all the viruses on BC fish farms, only PRV is more prevalent in farmed populations (page 11):
 - 70% on farms vs. 7% and 3% prevalence in wild Chinook and wild sockeye respectively (page 14); and
 - these data contradict the March 2018 Rapid Science Response's claim that SSHI's research published as Di Cicco (2017) established evidence of a marine reservoir of PRV it clearly did not make this claim and DFO staff had to know this.⁶
- PRV can be found in high concentrations (70% of farmed Chinook and 87% of farmed Atlantic salmon) without the audit program detecting disease (page 19).
- 0% of farmed Chinook with jaundice did not have PRV and only 3% of farmed Atlantic salmon with HSMI did not have PRV (page 20).
- 80% of all farmed Chinook with high loads of PRV were in a viral disease state (page 37).
- 93% of wild Chinook juveniles with high loads of PRV were in a viral disease state (page 38).

³ See the May 2014 statement published on DFO's website that is included in the Certified Tribunal Record ("CTR") filed by the Ministry of Fisheries and Oceans in Federal Court files T-1710-16 and T-430-18.

⁴ The front page is disclosed, but the rest of the paper is withheld. The public interest demands it be disclosed.

⁵ The manuscript was sent to at least Nathan Taylor, Cory Jackson, Jay Parsons, Andrew Thomson, and Carmel Lowe.

⁶ March 2018 Rapid Science Response, page 4.

- There is very compelling evidence that PRV plays more than a bystander role in causing disease:
 - deep sequencing on multiple fish with jaundice showed that only PRV is associated with jaundice and in situ hybridization and showed localization of PRV in the kidney and liver cells (page 199).
- Jaundice is consistent with viral etiology (being caused by a virus) (page 297), and PRV is the only virus correlated to jaundice (page 267).
- PRV could be affecting Chinook salmon differently than Atlantic salmon where it manifests as HSMI (page 297).
- Norway considers PRV infection in hatchery smolts a risk factor in HSMI outbreaks in marine net pens (page 1675).
- Norway now experiences freshwater outbreaks of HSMI, and when those outbreaks occur, there
 is increased mortality (up to 50%) in the marine environment (page 1678).
- Everywhere else PRV is found, it causes disease: coho in Chile and Japan and rainbow trout in Norway, Chile, and Washington State (page 1675).
- In Norway, HSMI, which is caused by PRV, quickly moved from affecting dozens to impacting hundreds of farms (page 1675).
- Norwegian scientists believe that they waited too long to track and report HSMI (page 1675).
- Norwegian scientists advised BC that it should begin tracking PRV and HSMI sooner rather than later (page 1675).
- PRV may contribute to co-infection pathologies that cause mortality and are likely currently undetected (page 1675).
- In BC, PRV is likely causative of diseases that manifest differently in Atlantic and Pacific salmon (page 1779).
- PRV is "clearly involved" in the necrosis of the liver and kidney in Chinook salmon (page 1779).
- PRV-related diseases are highly likely more prevalent than is currently understood (page 1780).
- DFO evidence shows that the same strain of PRV has a role in diseases in Atlantic and Pacific salmon. This information should be considered carefully when determining the risk that high concentrations of PRV in salmon farms pose to wild salmon in BC (page 1780).

Almost none of this information made it into the various documents used over the last three and half years to reaffirm the PRV Policy. And this is only what we know from what was revealed in the 01222-ATIP Release – over 1,300 pages were withheld that surely contain more information.

Given the exclusion of this important information from previous re-affirmations of the PRV Policy, we are deeply concerned that current reconsideration of the PRV Policy will not have all the relevant information at its disposal. We have enclosed the 01222-ATIP Release so that this information can be properly placed before the Minister's delegate to consider when considering any decision to re-affirm the PRV Policy. We note that as DFO has access to the complete and unredacted documents contained in the 01222-ATIP Release that the Minister's delegate must consider the complete and unredacted versions of those documents.

- Why was this evidence of harm not previously put before the Minister's delegate when affirming the PRV Policy?
- Given this exclusion of compelling evidence of harm, will the Minister's delegate continue to rely
 on previous affirmations of the PRV Policy for the current reconsideration? If so, then how will
 those previous affirmations be reconsidered in light of the information DFO has had for many
 years, but was not previously placed before the Minister's delegate?
- What is DFO currently doing to track PRV and HSMI given the advice from Norwegian scientists that DFO should be tracking this disease agent and disease?
- How is DFO compensating for the information gap created by its failure not to track PRV and HSMI sooner?
- How is DFO considering the evidence showing that the same strain of PRV has a role in diseases
 in Atlantic and Pacific salmon to determine the risk that high concentrations of PRV in salmon
 farms pose to wild salmon in BC? How has the risk to Chinook specifically been addressed?
- How is PRV being tracked in hatcheries?
- DFO claims that PRV is ubiquitous in wild salmon, but DFO's own data on prevalence shows PRV
 is considerably more prevalent in farmed than wild populations. This suggests that farmed
 salmon are likely the source of PRV in the marine environment.
 - How is DFO managing risk for this uncertainty so that it is adhering to the precautionary principle?
 - O How is DFO taking extra precautions to ensure that PRV does not pose a risk to our constitutionally protected title and rights?
- Given the evidence that DFO has that jaundice is caused by a virus and that PRV has more than a
 bystander effect in causing jaundice in Chinook, how does DFO plan to address the risk to wild
 populations of Chinook that we rely on to exercise our constitutionally protected title and rights?
- What research does DFO have on how PRV may lead to co-infection pathologies that cause mortality and are likely currently undetected? Has DFO detected such pathologies? What species of wild Pacific salmon has this research been conducted for? Please provide us all information you may have on co-infection pathologies.
- Given that PRV is likely causative of diseases that manifest differently in Atlantic and Pacific salmon has DFO conducted research on PRV-induced disease in all five species of wild Pacific salmon?
- How is DFO considering how PRV may contribute to co-infection pathologies in wild Pacific salmon?
- How is DFO managing the risk and uncertainty that PRV-related diseases are highly likely more prevalent than is currently understood?
- What research is DFO considering with respect to how PRV infection may induce different disease pathologies in farmed Atlantic salmon and wild Pacific salmon?
- How is DFO tracking strains of PRV in hatchery and farmed Atlantic salmon?

• Given that Washington State has twice prohibited transfers of smolts infected with PRV that is believed to originated in Iceland, how is DFO tracking the origin of PRV in farmed Atlantic salmon throughout the production cycle?

Information Requests:

- Please provide us with a copy of Dr. Miller's unpublished paper linking PRV to jaundice in Chinook so that we can assess how that research might inform any assessment of impacts to our constitutionally protected title and rights.
- Please provide us with the redacted pages in ATIP A-2017-01222/DSP pertaining to scientific research on PRV.
- Please provide us with any other copies of other research that DFO may have in progress with respect to the harm that PRV may pose to wild salmon.

Dr. Miller's Diagnosis of HSMI on a BC Fish Farm

Documents released under the *Access to Information Act* as ATIP A-2016-203 and ATIP A-2015-00948 demonstrate that Dr. Miller's team diagnosed HSMI, which is caused by PRV, by May 2016, but DFO staff and industry suppressed that diagnosis and forced Dr. Miller to announce, against her wishes, a "potential" diagnosis.⁷ Dr. Miller's team was only able to publish the paper confirming that diagnosis in 2017, four years after the data were collected in 2013, and a year after she was ready to go public with the diagnosis.

We have enclosed ATIP A2016-203 and ATIP A-2015-00948 for consideration by the Minister's delegate when reconsidering the PRV Policy.

- Why was Dr. Miller not allowed to announce unequivocally that her team had diagnosed HSMI?
- Why did it take so long to publish the Di Cicco (2017) paper that would report her results in a peer-reviewed journal?
- Between Dr. Miller's diagnosis of HSMI and the publication of Di Cicco (2017) the Minister's delegate re-affirmed the PRV Policy relying on documents that said HSMI was not present in BC, when clearly it had been diagnosed on a BC fish farm. Will the Minister's delegate continue to rely on those documents that state that HSMI was not present in BC, or will they be put aside or corrected?
- This suppression of Dr. Miller's research causes us great concern. Is there other research on PRV from researchers from DFO that has not been made public or published?

⁷ Please see in particular ATIP A2016-203 pages, 000066 to 000068, 000788, 000876, 000974, 001010-001011, 000209, 000646, 000799, 000859, 000897, 000788-000790, 000664-000666, 000884-000885, 000911, 000913, 000919 to 000920, 000984 to 000984, 00897, 000974 to 000975, 00978, as well as throughout ATIP A2016-203 and also see in particular ATIP A-2015-00948 at 00130-00131, 000332, 000611-000612,, 000644, 000625 to 000626, 000816, 000821, 000828-000830, 000876 as well as throughout ATIP A-2015-00948.

- Please provide us with a list of any PRV-related research that is currently in progress within DFO, including the status of that research.
- Please also include copies of any draft research results related to PRV.

Dr. Rimstad's Research on PRV from BC

Documents released under the *Access to Information Act* as ATIP A-2016-01101 (the "01101-ATIP Release") show that in November 2014, Dr. Kyle Garver of DFO emailed Dr. Espen Rimstad, a Norwegian expert on PRV, asking him to conduct a study to parallel Dr. Garver's research on PRV. (We describe two studies Dr. Garver conducted more fully below.)

We have enclosed ATIP A-2016-01101 to ensure that this information is placed before the Minister's delegate when reconsidering the PRV Policy.

Dr. Garver asked Dr. Rimstad to expose Atlantic salmon in Norway to PRV from BC.⁸ DFO shipped samples of PRV from BC to Dr. Rimstad in or around March 2015⁹ and Dr. Rimstad conducted his study in the summer of 2015.¹⁰ Dr. Garver may have had Dr. Rimstad's results around the same time that Dr. Miller was ready to announce that her team had diagnosed HSMI; Dr. Rimstad appears to report those results in an April 4, 2016, email to Dr. Garver, but that report is redacted.¹¹

Regardless, a July 29, 2016, draft of an internal DFO report on the progress of current ACRDP research says the PRV sent to Norway induced lesions. Despite this information, Andrew Thomson, Regional Director, Fisheries Management, in a January 27, 2017, memorandum to Rebecca Reid, Regional Director General, wrote that "Experimental exposures of the strain of PRV present in BC to Pacific and Atlantic salmon in BC have failed to induce disease or mortality." Ms. Reid relied on that January 2017 Memorandum to reaffirm the PRV Policy. We find it difficult to understand how Ms. Reid or Mr. Thomson could make, or rely on, such an unequivocal statement when DFO staff were well aware of Dr. Rimstad's results showing that PRV from BC induced lesions. Below, we describe the troubling

⁸ ATIP 2016-01101, pages 3 to 4.

⁹ ATIP-2016-01101, page 6.

¹⁰ ATIP-2016-01101, page 10.

¹¹ ATIP-2016-01101, page 39.

¹² Please see draft DFO document called "Aquaculture and Disease Related Research (Pacific Research)", dated July 29, 2016, that says Dr. Miller's research was suppressed because "the histopathologist from the province convinced industry not to sign off on the report (after many iterations) if PRV was to be included in the analysis". ATIP A-2016-01097, page 69: "a pilot study exposing Norwegian Atlantic salmon to PRV material from BC showed evidence of heart inflammation". Note that this draft is dated two years after Dr. Garver emailed Dr. Espen Rimstad, a Norwegian expert, to conduct a parallel study to the Garver studies by infecting Atlantic salmon in Norway with PRV from BC. See ATIP-2016-01101, page 3.

¹³ See CTR that DFO produced in T-430-18, Memorandum from Andrew Thomson to Rebecca Reid dated January 27, 2017, at page 4.

¹⁴ Note that in Mr. Thomson's memorandum, and elsewhere, DFO says that PRV did not induce "disease" or "mortality". Two important points: First, on mortality, just because fish did not die in a lab does not mean the virus does not pose a risk to wild fish. Second, on disease, as shown by the legal opinion previously provided, while the rest of the world diagnoses disease based solely on the presence of lesions, DFO has invented another diagnostic criterion ("clinical signs") to avoid diagnosing disease where the rest of the world would.

deficiencies with the Garver studies that should have prevented Ms. Reid and Mr. Thomson from relying on them.

In October 2016, Drs. Garver and Rimstad discuss using purified PRV from BC to induce disease¹⁵ and funding that research.¹⁶ In a 2018 affidavit, Dr. Garver affirmed that his collaboration with Norwegian researchers continues. A follow-up *Access to Information Act* request for any emails between Drs. Rimstad and Garver produced only one email confirming the delivery of samples.¹⁷ Dr. Garver may not be using his DFO email address to collaborate with Dr. Rimstad.

DFO has never released the results of Dr. Rimstad's studies and those studies were never considered when reaffirming the PRV Policy. It is hard not to conclude that DFO staff buried results of a study that provided evidence that could disrupt industry's current operations.

DFO must consider this information that it has in its possession when considering the PRV Policy and the potentially adverse impacts that PRV may cause to our constitutionally protected title and rights.

Questions:

- How does the Minister's delegate plan to address Dr. Rimstad's findings when re-considering the PRV Policy?
- Given that Dr. Rimstad's research was started as parallel to studies led by Dr. Garver, what do his results indicate about the conclusions found in Dr. Garver's studies?
- What do Dr. Rimstad's results indicate about the pathogenicity and virulence of PRV from BC?
- What other studies has DFO undertaken with respect to PRV that have been abandoned or unpublished?

Information Requests:

- Please provide us with the results of Dr. Rimstad's research on PRV from BC so we can assess his
 findings and use them to inform our assessment of how PRV may adversely impact our
 constitutionally protected rights.
- Please provide us with the copies of the results from Dr. Garver and Dr. Rimstad's follow up research on PRV that they discussed in October 2016 and any other research they may be collaborating on with respect to PRV.
- Please provide us with any other studies on PRV that have been undertaken by DFO or its contractors, even if those studies have not been completed.

¹⁵ ATIP-2016-01101, pages 45, 46, and 49 to 51. See also page 48. By this time, research on the PRV virus had advanced and researchers could extract the virus from tissue and purify it. They no longer had to rely on injecting fish with a slurry of tissue, but they could isolate the virus and inject it directly into the fish. This method eliminated confounding variables.

¹⁶ ATIP-2016-01101, pages 56 to 59.

¹⁷ ATIP-2016-01172.

Selection of Delegate's Advisors and Procedures for the Decision-making Process

Given the failure of DFO staff to place key information showing the risk that PRV may cause harm to wild Pacific salmon in previous iterations of the PRV Policy, 'Namgis is extremely concerned that the process and procedures for the current reconsideration of the PRV Policy will not meet the standards required for administrative decision-making.

Those concerns are further exacerbated by information revealed in the 01222-ATIP Release.

For the June 2018 Rapid Science Response, DFO relied on the BC Salmon Farmers Association's ("BCSFA") summary of a November 2017 scientific workshop on PRV and HSMI to attempt to rebut the findings of Di Cicco (2018). Using an industry advocacy group's summary to discredit peer-reviewed research by a DFO research team is inappropriate. Even more surprising, Dr. Lowe, who used that June 2018 Rapid Science Response to reaffirm the PRV Policy, already had summaries of that workshop from four DFO scientists (page 1681). At least one of those summaries provided a much fuller and unvarnished version of the workshop than the one prepared by the BCSFA (page 1678).

Ensuring Rapid Science Responses Are Assigned to Industry-Friendly Scientists

Troublingly, Dr. Lowe may have used those summaries to vet scientists when assigning the Rapid Science Responses. Dr. Lowe asked for those summaries on November 30, 2017 (page 1682), only a few weeks before she requested the March 2018 Rapid Science Response on December 27, 2017. As Dr. Miller noted in an email to the variances in the summaries are "quite telling" (page 1677). Only Dr. Miller's summary suggests that PRV-free smolts should be used (as this practice has been proven to reduce HSMI outbreaks in Norway) and suggests that DFO should be doing more to track HSMI (page 1678). Dr. Miller was excluded from the March and June 2018 Rapid Science Responses. Instead, Dr. Garver and Dr. Higgins each co-authored a Rapid Science Response. Their summaries did not contain any suggestion that DFO should change its approach to managing PRV (see pages 1672 to 1683).

The selection of scientists for the March 2018 Rapid Science Response is most telling. The ostensible purpose of the 2018 Rapid Science Response was to update the decision-maker on science published since the last affirmation of the PRV Policy in January 2017. By March 2018, peer-reviewed publications had cast significant doubt on the two Garver studies. DFO staff selected three co-authors of Garver (2016) (Dr. Garver, Dr. Stewart Johnson, and Dr. Mark Polinski) for the March 2018 Rapid Science Response. Unsurprisingly, those three DFO scientists did not identify how more recent research had overtaken their own findings.

Despite Dr. Miller's exclusion from the Rapid Science Responses used to reaffirm the PRV Policy, the 01222-ATIP Release shows that in the fall of 2017, Dr. Lowe relied on Dr. Miller for a different PRV-related Rapid Science Response related to the discharge of fish processing plant effluent (pages 1786 and 1787). Tellingly, that Rapid Science Response was used for a media response, not the PRV Policy.

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¹⁸ June 2018 Rapid Science Response, page 3.

It appears that the authors of the Rapid Science Responses were carefully vetted to ensure the "right" advice was provided. DFO selected scientists who knew what was expected. As Dr. Garver said during cross-examination, "In a rapid science response you're criticizing or basing your review on one paper; you're not doing a thorough review as in a scientific paper" (italics added). We have enclosed the transcript from the Cross-Examination of Dr. Kyle Garver dated August 29, 2018 with this letter.

Dr. Lowe Was Likely Able to Influence the Production of the Rapid Science Responses

Emails documenting the development of a Rapid Science Response related to discharge from a fish processing plant effluent pipe show that Dr. Lowe was actively involved in writing and editing it (pages 1786, 1794, 1805, 1806, 1840, 1841, and 1843). In contrast, DFO argued in Federal Court that the March and June 2018 Rapid Science Responses were prepared independently by DFO scientists, and Dr. Lowe was simply presented with them as advice to a decision-maker. The 01222-ATIP Release shows that she knew of the excluded evidence of PRV's harm to wild salmon and had the opportunity to ensure that evidence was not considered for any reaffirmation of the PRV Policy.

The information disclosed in the O1222-ATIP Release gives us great concern that the processes previously used to re-affirm the PRV Policy did not meet the basic minimum requirements of administrative fairness. We are gravely concerned that the current process will also lack the basic requirements of administrative fairness, with transparency and impartiality being of paramount concern. We are concerned that those deficiencies will affect the reasonableness, intelligibility and transparency of any decision reached and will adversely affect any consultation process with us.

- How will the Minister's delegate be selected to reconsider the PRV Policy?
- Will that delegate be an independent and objective decision-maker, or will he or she be an active participant in shaping the scientific advice?
- Who will be tasked with putting information before that delegate?
- Will the Minister's delegate be able to select the scientific advisors?
- How will the Minister ensure that objective and impartial information is put before the Minister's delegate?
- Will only scientists hand-picked by DFO be allowed to provide input in the decision-making process?
- How will DFO ensure that our experts can provide input into the process and provide comments on the findings of the CSAS process?
- How will information be generated and selected for review and consideration for the Minister's delegate?
- How will First Nations be able to place information and submissions on the risk PRV poses to its constitutionally protected rights and title before the Minister's delegate?

¹⁹Cross-examination of Dr. Kyle Garver, dated August 29, 2018, page 18, lines 9 to 12.

- What processes and procedures will be put in place to ensure that the process used to reconsider the PRV Policy meets the standards of administrative fairness, including transparency and impartiality?
- What processes and procedures will be put in place to ensure that the process used to reconsider the PRV Policy meets the standards required for the Crown to discharge its constitutional duty to consult and accommodate 'Namgis?
- How will the Crown notify other potentially affected First Nations of the reconsideration of the PRV Policy so that they can be consulted?

- Please provide us with the name of the Minister's delegate for the reconsideration of the PRV Policy.
- Please provide with the terms of reference for the reconsideration of the PRV Policy, including any procedural fairness to ensure the standards of administrative fairness are met.

Current Canadian Science Advisory Secretariat Review

The process of the current CSAS does not give 'Namgis comfort that the procedural flaws described above will be protected against.

The scope of the current CSAS review and the composition of the panel conducting are both troubling: they ensure evidence contrary to the PRV Policy is excluded and that those on the panel are predisposed to recommending the PRV Policy be maintained.

The current CSAS review of the PRV Policy is limited to the effect of PRV on Discovery Islands and Fraser River sockeye. This extremely narrow scope is wholly inadequate. The occasion demands an assessment of PRV's risk to all five species of wild Pacific salmon, not just sockeye, to say nothing of other marine life. As Dr. Garver explained in a 2018 affidavit for the *Morton 2019*, the effects of a pathogen on one species cannot predict the disease outcome for all species in all environments.²⁰ PRV is the perfect example: it causes HSMI in Atlantic salmon, jaundice in Chinook, and EIBS in coho.

Even if sockeye could legitimately be used as a proxy for all other species of wild Pacific salmon, the research available on PRV in sockeye is very limited; indeed, the laboratory evidence is comprised almost exclusively of the Garver studies. The previous Rapid Science Responses occurred behind closed doors and excluded unfavourable evidence. The current CSAS review will not occur behind entirely closed doors, but DFO staff have scoped the CSAS review to accomplish the same result: the focus on sockeye excludes the mounting research from around the world that PRV kills both coho and Chinook salmon.

We understand that DFO first attempted to exclude Dr. Miller from the CSAS review, but even after her appointment, the panel is still stacked with industry-friendly experts who will drown out any dissenting voices. 'Namgis, and others, requested that Alexandra Morton be included in the CSAS review.

²⁰ Affidavit of Dr. Kyle Garver submitted in Federal Court file T-430-18, paras. 14 to 17. We have enclosed this affidavit for consideration by the decision-maker.

Evidence of the composition of the CSAS drowning out dissenting voices emerged less than 24 hours after DFO provided an update to the CSAS review. In the update, DFO said that the CSAS panel had "reached a consensus that the risk to Fraser River sockeye salmon due to PRV is minimal." However, a member of the CSAS panel publicly disputed this statement reportedly saying that "no such consensus exists". As reported in the Campbell River Mirror, went on to say that the extremely high scientific uncertainty around PRV makes such a consensus almost impossible:
Too much uncertainty remains about PRV, according to with the David Suzuki Foundation.
"The uncertainty is extremely high, and there's no possible way that we can make any conclusion about the impacts of this pathogen on wild salmon in British Columbia," said in an interview on Friday. "I don't think there's a scientist out there that would argue otherwise."
But disputes the claim that PRV isn't a risk to sockeye.

"They're uncertain about how long the virus lives, they're uncertain about how far it spreads, and they're uncertain about the impact of PRV on other species of salmon," said
Claims by DFO about a low risk to sockeye salmon also imply that the virus doesn't affect wild salmon at all, which isn't the case, said.
"This is a very narrowly focused, narrowly mandated study," he added.
Aside from research showing that PRV causes mortality in chinook salmon, he said that unpublished evidence viewed by the peer-review group also points to risks for wild coho and chum salmon.
The peer-review study was restricted to PRV that spreads from fish farms in the Discovery Islands.
"Moving north through the Discovery Islands into the Johnstone Strait and the Queen Charlotte Strait, they're exposed to 20, 30 other fish farms," he said. "And that's not taken into consideration." ²¹
As indicated by, we understand that other scientist on the CSAS panel share his view in whole or in part, but are concerned confidentiality agreements they were required to sign as part of the CSAS review prevent them from speaking freely.

²¹ We have enclosed a copy of the February 8, 2019 Campbell River Mirror article with this letter. It can also be found here: https://www.campbellrivermirror.com/news/dissenter-from-group-of-scientific-experts-calls-foul-on-dfo-says-effects-of-fish-farm-virus-extremely-uncertain/.

'Namgis is extremely concerned that the Minister is using confidentiality agreements to enforce a scientific consensus and discourage the free exchange of scientific information between experts, and to the public in an effort to maintain the status quo with respect to the PRV Policy. We note that such conduct was seen as integral to DFO's mismanagement of the cod stocks on the Atlantic coast which caused the permanent collapse of the Atlantic cod fishery.²²

Given the increased transparency required when the precautionary principle is engaged (*Morton 2019*, para. 160), we are concerned that DFO and CSAS may be effectively using confidentiality agreements to silence scientists on this issue and present a false consensus when no such consensus exists.

We are also concerned that the Minister did not wait for the Court's determination in *Morton 2019* before convening the CSAS process. Normally, when a matter is before the courts, administrators and politicians are careful not to act in any way that could be perceived as interfering with or undermining the judicial process. The Minister did not wait for the Federal Court to rule on the lawfulness or reasonableness of the PRV Policy or if the duty to consult was engaged with respect to the PRV Policy. This is highly unusual conduct. Normally, a government agency has confidence its decision will withstand judicial scrutiny or has enough respect for Canada's judiciary to be informed by direction from the Federal Court.

By this time, the CSAS review is well-advanced in a way that may be prejudicial to 'Namgis' right to be consulted. We are concerned that the Minister's failure to include us early in the process will ensure that the process is too far advanced for our views to be meaningfully considered (*Musqueam Indian Band v. British Columbia*, 2005 BCCA 128 at para. 95) and that the process for reconsidering the PRV Policy will not allow for our meaningful input (*Dene Tha' First Nation v. Canada (Minister of Environment*), 2006 FC 1354 at paras. 107-110).

- Are the scientists that are part of the CSAS review subject to confidentiality agreements that prevent them from speaking openly about their findings and views?
- Given the need for transparency in the administrative decision-making process and the heightened need for transparency when the precautionary principle is engaged, why is the CSAS process being conducted behind closed doors, without First Nations' participation, and in a way that may prevent scientists from expressing their views?
- How will the confidentiality agreements that CSAS has imposed on its participants allow for First Nations to speak to scientific experts about the CSAS process? How will First Nations be able to get accurate information from all sides of the debate on PRV if CSAS, DFO and/or the Minister will not allow them to speak with us?
- Why was ______ not included in the CSAS process when 'Namgis, other First Nations and other participants expressly requested that she be included?

²² Canada. House of Commons 1997b. Standing Committee on Fisheries and Oceans. *Transcript of Evidence*, 9 December; Canada. House of Commons 1998a. Standing Committee on Fisheries and Oceans. *Transcript of Evidence*, 5 February; December Cameron, Silver Donald. 1998. Why Aren't Heads Rolling? *Globe and Mail*, 20 January. See also Brubaker, Elizabeth. "Unnatural Disaster: How Politics Destroyed Canada's Atlantic Groundfisheries" in *Political Environmentalism: Going Behind the Green Curtain*, edited by Terry L. Anderson, Hoover Institution Pres, 2000.

- Please provide the methods by which First Nations will be able to provide submissions on how not testing for PRV before transferring or introducing smolts into the marine environment may adversely affect their constitutionally protected title and rights.
- Please provide any terms of reference, minutes, meeting hotes, papers, reports, or other documents related to the CSAS review.
- Please provide us any information you have on the potential harm that PRV may cause to chum or coho salmon?

Reliance on Industry Authored Papers

Throughout the previous re-affirmations of the PRV Policy, the Minister's delegates have relied disproportionately on four papers without scrutiny and at the expense of research contrary to the PRV Policy: Garver (2015) and (2016), Siah (2015), and Marty (2015). Marine Harvest Canada Ltd. provided funding for three of those papers; its current managing director co-authored three of them.

The reluctance of DFO staff to consider the draft ACRDP research and Di Cicco (2018) paper is in stark contrast to the 2015 CSAS Science Response²³ reliance on draft versions of two of those papers – Garver (2015)²⁴ and Garver (2016).²⁵ DFO's continued reliance on these two papers is profoundly disturbing:

• Garver (2015) concluded that PRV does not cause jaundice. The 2015 CSAS Science Response and the June 2018 Rapid Science Responses say that the two Garver challenge studies showed "no histological evidence of Jaundice Syndrome". This is simply not accurate. On August 29, 2018, under cross-examination, Dr. Garver admitted that Chinook in that study had histological lesions consistent with jaundice. This is unsurprising. Garver (2015) expressly describes 10 different types of lesions in Chinook salmon exposed to PRV and confirms that fish in the control group had none of those same lesions. Ragain, under cross-examination, Dr. Garver admitted that at least one of those lesions, which occurred with 87% prevalence in the Chinook salmon exposed to PRV, is symptomatic of jaundice. Yet, in the face of this compelling evidence of PRV inducing disease response, DFO staff informed decision-makers for the PRV Policy that the study showed "no histological evidence" of jaundice.

²³ Science Response 2015/037: Assessment of the Occurrence, Distribution, and Potential Impacts of Piscine Reovirus on the West Coast of North America: http://www.dfo-mpo.gc.ca/csas-sccs/publications/scr-rs/2015/2015 037-eng.html.

²⁴ K.A. Garver, G.D. Marty, S.N. Cockburn, J. Richard, L.M. Hawley, A. Müller, *et al* (2015), Piscine reovirus, but not Jaundice Syndrome, was transmissible to Chinook Salmon, Oncorhynchus tshawytscha (Walbaum), Sockeye Salmon, Oncorhynchus nerka (Walbaum), and Atlantic Salmon, Salmo salar L., *Journal of Fish Diseases*: doi: 10.1111/ifd.12329.

²⁵ K.A. Garver, S.C. Johnson, M.P. Polinski, J.C. Bradshaw, G.D. Marty, H.N. Snyman, *et al* (2016), Piscine orthoreovirus from Western North America is transmissible to Atlantic Salmon and Sockeye Salmon but fails to cause Heart and Skeletal Muscle Inflammation, PLoS ONE 11(1): e0146229, doi:10.1371/journal.pone.0146229.

²⁶ June 2018 Rapid Science Response, page 3; 2015 CSAS Science Response, page 6.

²⁷ Cross-examination of Dr. Kyle Garver, dated August 29, 2018, page 36, lines 21 to 25.

²⁸ Garver (2016), pages 122 to 123.

²⁹ Cross-examination of Dr. Kyle Garver, dated August 29, 2018, page 37, lines 1 to 5.

• Garver (2016) was partially funded by Marine Harvest Canada Ltd. A co-author is currently the managing director of Mowi Canada West Ltd. (formerly Marine Harvest Canada Ltd.). Garver (2016) concluded that PRV from BC fails to induce HSMI in Atlantic or sockeye salmon. Several previous studies had succeeded in using PRV to induce lesions and/or disease. Since the publication of Garver (2016), Wessel (2017) has conclusively proven that PRV causes HSMI, and Di Cicco (2017) has diagnosed HSMI in BC. This subsequent research means it is impossible to rely on Garver (2016) for its conclusion that PRV from BC does not cause HSMI: PRV is the only known cause of HSMI and we have HSMI in BC. Wessel (2017) called the results of Garver (2016) "enigmatic". Di Cicco (2018) said Garver (2016) had been refuted by subsequent research. Another paper relied on by DFO staff in the March 2018 Rapid Science Response said that the methodology used by Garver (2016) may have contributed to its anomalous results. Not one of the documents used to affirm the PRV Policy ever makes any mention of the scientific community's doubts about Garver (2016). Instead, DFO staff relies on it without any scrutiny – even after it has been disproven.

The methodology of both Garver studies departed from what was previously known about detecting PRV-induced lesions. All previous challenge studies examined fish for lesions between 6 and 10 (or 12) weeks post challenge.³⁵ PRV infection peaks and then subsides. After it subsides, lesions may heal. The Garver research teams did not sample fish during that crucial 6- to 12-week window. Instead, Dr. Garver and his team waited until 22 weeks after exposure to PRV³⁶ when any lesions would have likely healed. Even then, they found 10 different types of lesions.

The Garver studies also used very small sample sizes and control groups, making their results unreliable. Despite the Garver studies expressly noting this unreliability, none of the materials relied on to reaffirm the PRV Policy consider this limitation.

Not only were the Garver studies designed to fail by avoiding the window when lesions would likely be detected, but the small sample sizes and control groups ensured the studies could be dismissed as unreliable if they succeeded. This scientifically flawed method appears to be the only way to support a conclusion that is incredulous: PRV from BC is magic PRV that does not cause disease when PRV causes disease everywhere else it is found.

It appears that DFO staff knew the Garver studies could not withstand scrutiny. Madame Justice Strickland was careful to note that DFO revised its position that PRV did not cause disease in the species challenged by Dr. Garver to state that "the species challenged by Garver 2016 failed to exhibit any symptoms of disease" (*Morton 2019*, para. 202). Further, as we have described above, Dr. Garver's

³⁰ See the list of studies on pages 15 and 16 of the 2015 CSAS Science Response.

³¹ Ø. Wessel, S. Braaen, M. Alarcon, H. Haatveit, N. Roos, T. Markussen, *et al* (2017), Infection with purified Piscine orthoreovirus demonstrates a causal relationship with Heart and Skeletal Muscle Inflammation in Atlantic salmon, PLoS ONE 12(8): e0183781, https://doi.org/10.1371/journal.pone.0183781.

³² Ibid., page 15.

³³ Di Cicco (2018), page 633.

³⁴ T. Meyers (2017), Piscine orthoreovirus (PRV) in the Pacific Northwest appears to be of low risk to wild Pacific Salmonids, https://drive.google.com/file/d/10xHv7GXddmEXA7pRH4N4MGACzdZUhUL8/view.

³⁵ Please see the table of challenge studies included in the 2015 CSAS Science Response, pages 14 and 15.

³⁶ Cross-examination of Dr. Kyle Garver, dated August 29, 2018, page 30, lines 19 to 25 and page 31, lines 1 to 6.

collaboration with Dr. Rimstad established that PRV from BC causes disease. Dr. Rimstad also told Dr. Garver to not waste his time researching whether or not PRV causes disease, as we have conclusive proof that it does,³⁷ and questioned the methods Dr. Garver used.³⁸

Dr. Rimstad's comments demonstrate how the Garver studies are outside the mainstream science on PRV. Scientists discovered HSMI in 1999. It was first associated with PRV in 2010. By the time Garver (2016) was published, the rest of the scientific community was ready to accept that PRV caused HSMI in Atlantic salmon, though a key, traditional step in generating conclusive proof had not yet been attained. Garver (2016) failed to induce HSMI from exposure to PRV when most other studies had. Shortly afterwards, Wessel (2017) purified PRV and conclusively proved PRV causes HSMI.

Garver (2015) has the same unfortunate relationship with the current trajectory of mainstream scientific literature on PRV in Pacific salmon. In 2011, Dr. Miller associated PRV with disease in Chinook. PRV causes EIBS in coho. It is likely that challenge studies using purified PRV will soon prove that PRV causes jaundice in Chinook. Evidence is accumulating that PRV is native to Atlantic salmon and is a foreign introduction to BC. Washington State has concluded that the strain of PRV found in Atlantic salmon hatcheries there originated in Iceland.

Despite all this, DFO staff continued to rely on the Garver studies to say that PRV from BC is of low pathogenicity and reaffirm the PRV Policy.³⁹

This troubling reliance on Garver (2015) and (2016) is undermined by the evidence Dr. Garver himself gave in *Morton 2019*. In Dr. Garver's affidavit of July 4, 2018, he explained that three factors are crucial in predicting disease outcome: host, pathogen and environment. He further explains that a disease outcome based on one combination of host, pathogen and environment cannot be used to predict outcomes in different combinations. That is, an experiment using PRV on a select sub-set of salmon populations in the lab cannot be used to predict or evaluate risk for all species of wild Pacific salmon in the different environments, and environmental stressors, they will face in the wild.

As Dr. Garver confirmed in his July 17, 2018 cross-examination on affidavit, neither Garver (2015) or Garver (2016) studied the effects on all species of wild Pacific salmon, or even a broad sample of populations within the species that those two studies did include. During that cross-examination, Dr. Garver further confirmed that Garver (2015) and Garver (2016) did not attempt to replicate the conditions Pacific salmon would face in the wild and could not be used to conclude that PRV may not cause harm to wild Pacific salmon.

We have enclosed the Affidavits of Dr. Garver dated July 4, 2018 and July 25, 2018 together with a copy of the transcript from each of the cross-examinations of Dr. Garver held on July 17, 2018 and August 29, 2018.

³⁷ ATIP-2016-01101, pages 9.

³⁸ ATIP-2016-01101, pages 9, 22 to 23.

³⁹ See Memorandum from Andrew Thomson to Rebecca Reid, dated January 26, 2017, which was used to affirm the PRV Policy in January 2017. See also the 2015 CSAS Science Response, pages 7 and 8.

⁴⁰ See paragraphs 14 to 18 of that affidavit.

DFO relies on two other papers that are outside the scientific mainstream. Siah (2015)⁴¹ concluded that PRV could not be a recent introduction to the Pacific. The authors subsequently retracted that conclusion in a rare correction.⁴² Yet, in subsequent re-affirmations of the PRV Policy, DFO staff continued to rely on Siah (2015) for the PRV Policy and have not acknowledged that correction. Similarly, Marty (2015) reported evidence that PRV was potentially present in BC before fish farms of Atlantic salmon began to operate, in previous affirmations of the PRV Policy, DFO scientists did not acknowledge that the first non-suspect detection of PRV in wild salmon came in 1988, years after fish farms of Atlantic salmon appeared on the BC coast.

Questions:

- Will DFO scientists continue to rely on the four papers mentioned above, without scrutiny, despite their short-comings?
- How will DFO scientists address those papers?
- Why have previous affirmations of the PRV Policy not addressed the short-comings manifest in those papers?
- Will the Minister's delegate continue to rely on past affirmations of the PRV Policy despite their failure to adequately address the issues in those the four papers mentioned above?
- How will the Minister's delegate ensure that DFO staff do not misrepresent findings for scientific papers as happened with those four papers?
- Will DFO continue to rely on research co-funded and co-authored by aquaculture companies who could benefit from the continuation of the PRV Policy?
- Will DFO provide the same research and funding opportunities for First Nations and other interested parties to conduct research that could provide evidence that is contrary to the continuation of the PRV Policy?

Information Requests:

 Please provide us copies of any scientific papers, studies or ongoing research that the Minister's delegate will rely on when considering the PRV Policy.

Studies Subsequent to Di Cicco (2017) and (2018)

In Morton 2019 the Court noted that Minister's delegate failed to address the uncertainties related to PRV and HSMI with respect to wild Pacific salmon that were illustrated by the publication of Di Cicco (2017), which confirmed that HSMI was present on BC fish farms (para. 202). Similarly, the Minister's delegates also failed to address the prevalence of HSMI on BC fish farms might have on the risk of disease and disease transmission in wild Pacific salmon (para. 205). The Court also noted that the Minister's delegate had failed to address how Di Cicco (2017) (para. 211), as a novel finding that HSMI

⁴¹ A. Siah, D.B. Morrison, E. Fringuelli, P. Savage, Z. Richmond, R. Johns, *et al* (2015), Piscine reovirus: Genomic and molecular phylogenetic analysis from farmed and wild salmonids collected on the Canada/US Pacific coast, PLoS ONE 10(11):e0141475, doi:10.1371/journal.pone.0141475.

⁴² A. Siah, D.B. Morrison, E. Fringuelli, P. Savage, Z. Richmond, R. Johns, *et al* (2016), Correction: Piscine reovirus: Genomic and molecular phylogenetic analysis from farmed and wild salmonids collected on the Canada/US Pacific coast, PLoS ONE 11(10): e0164926, doi:10.1371/journal.pone.0164926.

was present on BC fish farms, could adversely affect 'Namgis' constitutionally protected title and rights (para. 318).

Di Cicco (2017) also noted that despite it diagnosing HSMI, DFO's Fish Health Audit and Surveillance Program failed to do so. It also raised the issue that PRV poses to wild salmon and notes that further studies on this issue will be required, including further challenge studies in both Atlantic and Pacific salmon.

We understand that in 2018 multiple fish farms in BC experienced mortality above what is normally expected. We also understand that many of those same farms experienced symptoms associated with HSMI.

Di Cicco (2018) found that the exact same strain of PRV that causes HSMI in BC fish farms likely causes the red blood cells of Chinook salmon to explode *en masse*. Di Cicco (2018) noted that there is consistent evidence of rupturing of the red blood cells in PRV-associated diseases around the world.

Di Cicco (2018) noted that an "epidemiological study is currently underway to assess the role of salmon farms in the transmission of PRV to wild stocks, based on both patterns of prevalence distributions and full genome sequencing of the virus across farmed and wild populations over multiple years and geographic locations." It also noted that to confirm the association between PRV and disease in Chinook, new challenge studies should be conducted.

The Court noted that Di Cicco (2018) directly raised the risk that PRV may pose to wild Pacific salmon (paras. 210 and 211), and that despite DFO's criticism of that paper's methods, DFO did not re-assess or revisit the risks Di Cicco (2018) identified using DFO's preferred methodology.

- How has DFO re-assessed its auditing program given its failure to detect and diagnosis HSMI?
- How has DFO re-evaluated data that it relied on from its auditing program to assess the risk actual presence of disease in BC fish farms and the risk that PRV may pose to wild Pacific salmon?
- Since Di Cicco (2017) have there been other diagnoses of HSMI on BC fish farms?
- Does DFO still require clinical signs to diagnose HSMI?
- How does DFO plan to assess the impact that PRV might have on 'Namgis' constitutionally protected rights and title given:
 - the results of Di Cicco (2017) and (2018);
 - the necessary re-evaluations of DFO's auditing program; and
 - O DFO's conclusions on the risked identified by Di Cicco (2018)?
- Given the results of Di Cicco (2018) suggest that Chinook may be more prone to significantly
 adverse disease outcomes as a result of exposure to PRV, how has DFO investigated and
 addressed the risk that PRV may be a recent introduction to BC?
- What are the results of the epidemiological study mentioned by Di Cicco (2018)?

- What are the results of the challenge studies that Di Cicco (2018) suggested were necessary to confirm that PRV causes disease in Chinook salmon?
- What caused the increased mortality rates on BC fish farms in 2018?

- Please provide us with:
 - o the audit samples that were collected during the Di Cicco (2017) study;
 - o any results from the epidemiological study mentioned by Di Cicco (2018);
 - o any results of any challenge studies conducted on Pacific salmon using PRV; and
 - o any assessment of the potential adverse impacts on our constitutionally protected title and rights based on any of the above studies.
- Please provide us with the audit sample results, or any other data collected, from the fish farms that experience increased mortality in 2018.
- Please provide us with your re-assessment of the risk identified by Di Cicco (2018).
- Please provide us with the data collected in its auditing program for those fish farms that experienced increased mortality rates in 2018.

Area Based Management

The Minister's public statements on the PRV Policy have indicated that Area Based Management ("ABM") will play a role in DFO's future risk assessments and methods for managing risk. We have not been provided with any substantive information on how DFO Plans to use ABM or any information on the role ABM may play in managing risk with respect to PRV.

Information Requests:

- Please provide us with any information that DFO has on ABM.
- Please provide us with any information on ABM that was used or considered by the CSAS process or will be used by the Minister's delegate.
- Please also provide us with any information on the role ABM may play in DFO's PRV Policy.

Evidence of Risk PRV Poses to All Five Species of Wild Salmon

'Namgis is extremely concerned that there is an imminent risk from PRV to wild Pacific salmon and to 'Namgis' constitutionally protected title and rights. 'Namgis is also extremely concerned that up until this point all previous affirmations of the PRV Policy have focused almost exclusively on the potential risk to farmed Atlantic salmon and have not given any consideration to the potential impacts to 'Namgis' constitutionally protected title and rights (*Morton 2019*, para. 317).

So that the Minister's delegate can be apprised of our views on how the our Aboriginal title and rights could be adversely impacted by any continuation of the PRV Policy, in addition to the documents we have identified above, we have enclosed the documents listed below:

- Affidavit of Chief Don Svanvik, dated March 7, 2018, (previously described above) in which
 Chief Svanvik describes, among other things, our Territory, our Aboriginal title and rights, the
 Minister's knowledge of our rights, the importance of wild Pacific salmon to our exercise of our
 Aboriginal title and rights, the declining populations of wild Pacific salmon in our Territory, our
 conservation and stewardship efforts, and the potential adverse impacts that could be caused to
 our Aboriginal title and rights if the PRV Policy is continued and applied in our Territory.
- Affidavit of Dr. Martin Krkosek, dated March 7, 2018, (previously described above) in which
 Dr. Krkosek explains, among other things, that 41 populations of wild Pacific salmon in 'Namgis
 Territory are vulnerable to additional stressors and whose survival could be threatened by the
 continuation of the PRV Policy due to PRV increasing mortality and reproductive failures in those
 populations, causing declines in population size and genetic diversity, and/or reducing the
 capacity for adaptation to additional stressors.
- Affidavit of Dr. Martin Krkosek, dated May 14, 2018, (previously described above) in which Dr. Krkosek explains, among other things, that the need for the Minister's delegate to consider the following factors with respect to wild Pacific salmon in our Territory when considering the PRV Policy:
 - the extent to which PRV may spread from the marine environment to wild salmon in our Territory;
 - the effects of PRV infection on the ecological components of fitness, which are the primary determinants of mortality, migratory failure and reproductive failure of wild salmon in the ecological setting;
 - o the nature of the sampling techniques used when assessing wild populations and the potentially inherent bias when sampling wild fish;
 - o the problematic nature of assessing harm at a population level; and
 - the ability of farms of Atlantic salmon to function as a reservoir host population that maintains a virus population that can spread into an imperilled wild host population, among other things.
- Affidavit of Dr. Fred Kibenge, dated March 6, 2018, in which Dr. Kibenge describes, among other things:
 - the presence of PRV and HSMI in farmed and wild Pacific salmon in BC;
 - o that PRV is likely not native to BC;
 - the various impacts that PRV can have on fish health;
 - the ability of PRV to remain infective in the marine environment;
 - the ways in which fish farms amplify and spread disease;

- o how proximity to aquaculture facilities increases the risk of PRV infection;
- o how fish farms in our Territory are a significant source of PRV in our Territory;
- how PRV causes adverse health impacts in wild Pacific salmon by damaging the red blood cells;
- o how PRV is associated with multiple adverse health effects in Atlantic and Pacific salmon;
- how PRV reduces cardiovascular and athletic capacity in Atlantic and Pacific salmon;
- how stressful events experienced by wild Pacific salmon may cause or exacerbate adverse health effects in wild Pacific salmon;
- o how those adverse health effects likely reduce the ability of wild Pacific salmon to escape predation and spawn successfully;
- how transferring PRV-infected smolts will likely cause irreparable harm to wild Pacific salmon in our Territory; and
- o how DFO's previous risk assessments for PRV and HSMI have been inadequate, among other things.
- Affidavit of Dr. Fred Kibenge, dated March 19, 2018, in which Dr. Kibenge explains, among
 other things, that the test results obtained by Marine Harvest Canada Ltd. for smolts to be
 transferred into the Swanson Island fish farm are inadequate.
- Affidavit of Dr. Fred Kibenge, dated May 14, 2018, in which Dr. Kibenge explains, among other things, that:
 - DFO has deviated without explanation from internationally accepted standards for diagnosing HSMI;
 - DFO relied on, without scrutiny, DFO's own failure to induce disease from PRV despite should results being replicated many times elsewhere;
 - DFO ignored or dismissed evidence that PRV is not native to BC;
 - DFO minimized evidence that salmon farms are the greatest source of PRV in the marine environment; and
 - O DFO mistakenly relied on mortality levels in farmed Atlantic salmon to assess potential impacts to wild Pacific salmon, among other things.
- Affidavit of Dr. Fred Kibenge, dated July 24, 2018, in which Dr. Kibenge explains the significance
 of Di Cicco (2018) and its contribution to the science PRV's potential to cause disease and the
 inadequacies and flaws of the June 2018 Rapid Science Response's critique of Di Cicco (2018),
 among other things.

- Affidavit of Dr. Richard Routledge, dated February 27, 2018, in which Dr. Routledge explains, among other things:
 - the likelihood that PRV present in a fish farm in our Territory would likely infect populations of wild salmon which we rely on to exercise our constitutionally protected title and rights;
 - o the amount of PRV particles that one fish farm may produce; and
 - the distances that PRV may be able to travel in the marine environment, among other things.
- Affidavit of Dr. Richard Routledge, dated May 14, 2018, in which Dr. Routledge explains, among other things, that:
 - o how DFO's reliance on the premise that PRV does not cause disease is faulty;
 - how DFO's auditing program has produced unreliable data and DFO's knowing reliance on that data; and
 - how the reliance on disease outcomes in farmed salmon cannot be used to predict disease outcome in wild Pacific salmon.

The affidavits listed above were current to the last affirmation of the PRV Policy in June 2018. Some of them are specific to the risk posed by transferring PRV-infected smolts into the Swanson Island fish farm. However, as the Svanvik Affidavit makes clear, we exercise our Aboriginal right to fish through the Broughton Archipelago, Johnstone Strait and surrounding environs. Once you have begun consultation with us, we may provide more information on the potential harm from PRV emanating from other fish farms in the areas where we exercise our Aboriginal right to fish may cause adverse impacts to our Aboriginal title and rights.

Once you have answered the questions above, provided us with the information requested above and any other information you may provide to us, we may provide further information you may need to make further submissions on how the continuation of the PRV Policy may affect our constitutionally protected Aboriginal title and rights.

- How has the Minister's delegate specifically considered the risk that PRV poses to the declining populations of wild Pacific salmon in our Territory?
- How has the Minister's delegate specifically considered how and where we exercise our Aboriginal right to fish for food, social and ceremonial purposes, and how the spread of PRV may affect our exercise of those rights?
- How has the Minister's delegate specifically considered our stewardship and governance rights associated with our Aboriginal title and our Aboriginal right to fish, our title and rights will be impacted by any reconsideration of the PRV Policy?

- How has the Minister's delegate considered how allowing PRV-infected fish into our Territory will impact our stewardship activities, including but not limited to, our hatchery operations?
- How has the Minister's delegate specifically considered the risk to the 41 vulnerable populations
 of wild Pacific salmon in our Territory, the potential adverse impacts that PRV may have on
 those populations and how those adverse impacts can be avoided or mitigated through
 accommodations acceptable to us?
- How has the Minister's delegate specifically considered each of the five factors Dr. Krkosek identifies in his May 14, 2018 affidavit for each of the 41 vulnerable populations of wild Pacific salmon in our Territory?
- How has the Minister's delegate addressed the following issues:
 - o the presence of PRV and HSMI in farmed and wild Pacific salmon in BC;
 - o the evidence that PRV is likely not native to BC;
 - o the various disease and health impacts that PRV can have on fish health;
 - o the ability of PRV to remain infective in the marine environment;
 - the ways in which fish farms amplify and spread disease;
 - o how proximity to aquaculture facilities increases the risk of PRV infection;
 - o how fish farms in our Territory are a significant source of PRV in our Territory;
 - how PRV causes adverse health impacts in wild Pacific salmon by damaging the red blood cells;
 - o how PRV is associated with multiple adverse health effects in Atlantic and Pacific salmon;
 - o how may PRV reduce cardiovascular or athletic capacity in Atlantic and Pacific salmon;
 - how stressful events experienced by wild Pacific salmon, which may not be experienced by farmed salmon, may cause or exacerbate adverse health effects in wild Pacific salmon;
 - how those adverse health effects likely reduce the ability of wild Pacific salmon to escape predation and spawn successfully;
 - how transferring PRV-infected smolts will likely cause irreparable harm to wild Pacific salmon in our Territory; and
 - o how DFO's previous risk assessments for PRV and HSMI have been inadequate?

- How has the Minister's delegate considered:
 - DFO's past deviation from internationally accepted standards for diagnosing HSMI has affected the data from its auditing program;
 - DFO's past reliance, without scrutiny, DFO's own failure to induce disease from PRV despite should results being replicated many times elsewhere;
 - o growing evidence PRV is not native to BC;
 - o considered that salmon farms are the greatest source of PRV in the marine environment;
 - o the limitations of relying on mortality levels in farmed Atlantic salmon to assess potential impacts to wild Pacific salmon;
 - the inability to rely on data collected on specific strains of Atlantic farmed salmon to predict potential disease outcomes in wild Pacific salmon; and
 - o the inability to rely on laboratory experiments to predict disease outcomes in wild Pacific salmon?
- How has Minister's delegate reconsidered the significance of Di Cicco (2018) and its contribution to the science PRV's potential to cause disease?
- How has the Minister's delegate considered:
 - the likelihood that PRV present in a fish farm in our Territory to infect populations of wild salmon which we rely to exercise our constitutionally protected title and rights;
 - the number of PRV particles that one fish farm may produce;
 - o the distances that PRV may be able to travel in the marine environment; and
 - o other disease vectors created by salmon farming that may allow PRV to spread throughout our Territory?

• Please provide us with our responses to the issues raised in the Svanvik Affidavit and the affidavits from Drs. Routledge, Kibenge and Krkosek.

The Potential Adverse Impacts to Our Constitutionally Protected Rights are Irreparable

That PRV poses a risk to wild Pacific salmon and our constitutionally protected Aboriginal title and rights is unassailable:

- PRV is found in high concentrations in Atlantic salmon farms along BC's coast.
- PRV causes HSMI in Atlantic salmon.

- The same strain of PRV causing HSMI on fish farms causes the red blood cells of Chinook to rupture, releasing toxins into their livers and kidneys and killing many of the infected fish.
- PRV also causes EIBS in coho salmon.
- Severely depleted Chinook populations are the preferred food source of endangered killer whales.

DFO researchers have established a clear and profound risk to wild Pacific salmon from the PRV originating in fish farm hatcheries. We rely on all five species of wild Pacific salmon to exercise our constitutionally protected Aboriginal title and rights. We remain extremely concerned that DFO does not have enough information to assess the potential risk to all five species of wild Pacific salmon.

We also remain extremely concerned that the Crown has not provided us any information on how PRV may impact our constitutionally protected Aboriginal title and rights. As the Court in *Morton 2019* noted "the question of whether a failure to test for PRV or HSMI may potentially adversely affect 'Namgis', s. 35 rights will remain an open one until the Policy has been reconsidered (para. 317). The Minister has a constitutional duty to ensure that we are consulted and accommodated regarding any such decision. To date, neither the Minister, nor any representative of the Crown, has contacted us to begin such consultation.

We are concerned that any continuation of the PRV Policy could adversely impact our Aboriginal title, our Aboriginal right to fish for food, social and ceremonial purposes, and our Aboriginal right to provide stewardship over our resources. Consultation on the deep end of the *Haida* spectrum is needed urgently so that the Crown's reconsideration of the PRV Policy can be informed by our input and assess the policy's potential impact on our interests. Consultation on these important issues is required so that we can discuss how our potential adverse impacts to our constitutionally protected rights can be avoided, mitigated or accommodated.

Please contact me as soon as possible to begin that consultation.

Dera Smirik

Sincerely,

'Namgis First Nation

Per:

Chief Don Svanvik

cc. Rebecca Reid, Regional Director General, Fisheries and Oceans Canada, Rebecca.Reid@dfo-mpo.gc.ca

The Right Honourable Justin Trudeau, pm@pm.gc.ca

Tim Timberg, General Counsel, Department of Justice, Tim.timberg@justice.gc.ca

First Nations Fisheries Council,

Union of British Columbia Indian Chiefs,

British Columbia Assembly of First Nations,

s.19(1)

No attachments included

Encl. Affidavit of Chief Don Svanvik, dated March 7, 2018

Affidavit of Dr. Martin Krkosek, dated March 7, 2018

Affidavit of Dr. Martin Krkosek, dated May 14, 2018

Affidavit of Dr. Fred Kibenge, dated March 6, 2018

Affidavit of Dr. Fred Kibenge, dated March 19, 2018

Affidavit of Dr. Fred Kibenge, dated May 14, 2018

Affidavit of Dr. Fred Kibenge, dated July 24, 2018

Affidavit of Dr. Richard Routledge, dated February 27, 2018

Affidavit of Dr. Richard Routledge, dated May 14, 2018

Affidavit of Dr. Kyle Garver, dated July 4, 2018

Affidavit of Dr. Kyle Garver, dated July 25, 2018

Transcript - Cross-examination of Dr. Kyle Garver dated July 17, 2018

Transcript - Cross-examination of Dr. Kyle Garver, dated August 29, 2018

ATIP-2017-01222/DSP

ATIP-2016-01101

ATIP A-2016-203

ATIP A-2015-00948

Article from the February 8, 2019 Campbell River Mirror

	DFO MISREPRESENTATION	DFO MISREPRESENTATIONS OF SCIENTIFIC FINDINGS	
DFO Misrepresentation	Statement in Scientific Literature	'N <u>a</u> mgis Comments	'Namgis Questions
	2015 CSAS Sci	2015 CSAS Science Response	
Page 3: "The lesions reported in fish with HSMI are similar to those that are reported for other diseases such as PD (caused by salmonid alphavirus), CMS (caused by piscine myocarditis virus), and a recently described disease in Rainbow Trout that is associated with the presence of genetic material from a reovirus related to PRV (Kongtorp, Taksdal, and Lyngoy 2004; Olsen et al 2015). For this reason, HSMI cannot be definitively diagnosed by histopathology, unless the affected fish on the farm also have clinical signs consistent with HSMI."	"It is concluded that HSMI is histopathologically distinguishable from PD [Pancreas Disease] and CMS [Cardiomyopathy Syndrome]."43 "Pancreas disease and CMS [Cardiomyopathy Syndrome] are the most relevant differential diagnoses to HSMI at the histopathological level"."In this study, we followed the diagnostic case definition used by Biering and Garseth, wherein the diagnosis of HSMI is based on histological inflammatory lesions occurring in heart and skeletal muscle but not in the pancreas. However, while inflammatory lesions in the skeletal muscle may indicate HSMI at the population-level, and in particular can help to differentiate HSMI from CMS, skeletal muscle lesions are not consistently present throughout an entire HSMI outbreak, and hence are	The statement quoted from the 2015 CSAS Science Response is the only justification DFO has provided for departing from the standard method for diagnosing HSMI: evidence of histopathological lesions in heart and skeletal muscle. DFO says it needs to include "clinical signs" to differentiate HSMI from PD and CMS. Notably, DFO does not provide any citation to any scientific paper for its statement clinical signs are required to distinguish HSMI from PD and CMS. Simply put, there are none. As the papers cited in the second column (and others) illustrate scientists have distinguished HSMI from PD and CMS using histopathology since long before DFO claimed "clinical signs" were necessary to do so. And, as Di Cicco (2017) illustrates, DFO scientists continue to distinguish HSMI from PD	 Does DFO still require clinical signs to diagnose HSMI? The Certified Tribunal Record before the Court in Morton 2019 led Madame Justice Strickland to conclude that DFO may no longer be requiring clinical signs to diagnose HSMI (see Morton 2019, paras. 201 and 207). If DFO has abandoned its insistence on clinical signs for diagnosing HSMI, has it reevaluated previous instances of idiopathic cardiomyopathy to determine if those diagnoses should be considered HSMI? Has such a re-evaluation caused DFO to re-evaluate the role HSMI plays in farm mortalities?

⁴³ Kongtorp, R. T., T. Taksdal, and A. Lyngoy. 2004. Pathology of heart and skeletal muscle inflammation (HSMI) in farmed Atlantic salmon Salmo salar. Diseases of Aquatic Organisms. 59: 217-24, page 217.

⁴⁴ Kongtorp, R. T., A. Kjerstad, T. Taksdal, A. Guttvik, and K. Falk. 2004. Heart and skeletal muscle inflammation in Atlantic salmon, Salmo salar L.: a new infectious disease. Journal of Fish Diseases. 27: 351-58, page 27.

	DFO MISREPRESENTATION	DFO MISREPRESENTATIONS OF SCIENTIFIC FINDINGS	
DFO Misrepresentation	Statement in Scientific Literature	'Namgis Comments	'Namgis Questions
	level of the individual fish. Details of the histological classification of the heart and skeletal muscle lesions are reported in the Histopathology section. We did not use any other inclusion criteria (e.g. mortality, concurrent clinical signs, or molecular results with specific cut-off values) to modify our case definition for HSMI disease, as these criteria have been previously considered to be unreliable indicators throughout an entire HSMI outbreak." "Negative molecular tests for SAV and PMCV along with the absence of typical lesions reported for PD (pancreas involvement) and CMS (epi-myocarditis, but only atrium and spongy layer of the myocardium typically affected, and no skeletal muscle involvement) further strengthened the final diagnosis [of HSMI]""6.	even more tellingly, as DFO confirms on page 9 of the 2015 CSAS Science Response, the viruses that cause PD and CMS are not even present in BC. Not only is DFO's "justification" for departing from the prevailing science on HSMI and requiring "clinical signs" unfounded in the science, the diseases that DFO says it needs to distinguish HSMI from are not even present in BC. More recently DFO scientists have published a paper acknowledging that HSMI is distinguished from PD and CMS by histological examination: Currently, histolopathology is still used to diagnose clinical HSMI and also to differentially diagnose subclinical cases of HSMI, cardiomyopathy syndrome (CMS) and pancreas disease (PD) in farmed Atlantic salmon of Norway. Although these diagnoses are made solely upon histological evaluations, it is generally accepted that the primary agent responsible for each disease is a unique virus: PRV is the primary agent responsible for HSMI. piscine	

⁴⁵ Di Cicco E, Ferguson HW, Schulze AD, Kaukinen KH, Li S, Vanderstichel R, et al (2017) Heart and skeletal muscle inflammation (HSMI) disease diagnosed on a British Columbia salmon farm through a longitudinal farm study. PLoS ONE 12(2): e0171471. doi:10.1371/journal.pone.0171471, page 3.

⁴⁶ Di Cicco E, Ferguson HW, Schulze AD, Kaukinen KH, Li S, Vanderstichel R, et al (2017) Heart and skeletal muscle inflammation (HSMI) disease diagnosed on a British Columbia salmon farm through a longitudinal farm study. PLoS ONE 12(2): e0171471. doi:10.1371/journal.pone.0171471, page 23.

	DFO MISREPRESENTATION	DFO MISREPRESENTATIONS OF SCIENTIFIC FINDINGS	
DFO Misrepresentation	Statement in Scientific Literature	'Namgis Comments	'Namgis Questions
		myocarditis virus (PMCV) is the primary agent responsible for CMS, and salmon alpha virus (SAV) is the primary agent responsible for PD.	
		See "Piscine orthoreovirus demonstrates high infectivity but low virulence in Atlantic salmon of Pacific Canada" by Mark P. Polinski, Gary D. Marty, Heindrich N. Snyman & Kyle A. Garver, Scientific Reportsvolume 9, Article number: 3297 (2019).	
		The 2015 CSAS Science Response's insistence on clinical signs is also contradicted by DFO's current web page on PRV and HSMI. That web page says that HSMI is diagnosed by histopathology and makes no mention of clinical signs:	
		"The disease HSMI is diagnosed by the occurrence of histopathologic lesions in the heart and skeletal muscle; moderate to severe panmyocarditis (inflammation in the compact and spongy layers of the myocardium); and myocardial degeneration and necrosis (Biering and Garseth 2012). The skeletal muscle also	
		shows moderate to severe myodegeneration and necrosis of the red muscle fibres, as well as inflammation (Kongtorp et al 2004a). Lesions in the skeletal muscle tend to occur mostly during the peak of the outbreak and, to a lesser extent, in the	

	DFO MISREPRESENTATION	DFO MISREPRESENTATIONS OF SCIENTIFIC FINDINGS		
DFO Misrepresentation	Statement in Scientific Literature	'N <u>a</u> mgis Comments	'Namgis Questions	
		recovery phase (Kongtorp <i>et al</i> 2006). Histopathological lesions in other organs include liver necrosis and congestion / hemorrhages in liver, kidney, spleen and gills (Kongtorp <i>et al</i> 2004a)." Is DFO admitting it was wrong about "clinical signs"? Or, is DFO publicly saying that it adheres to the science on how to diagnosis HSMI, but privately, continuing to allow its technicians to		
		avoid diagnosing HSMI on BC fish farms.		
recent testing of archived samples held by DFO's Pacific Aquatic Animal Health Section revealed that PRV has been present in salmonids on the Pacific Coast of North America for a much longer time, as tissues preserved for histopathology over the period of 1987 through to 1994 were positive for PRV, with a suspect detection in wild Steelhead Trout from 1977 (Marty <i>et al</i> 2014). Detection of PRV in these archival samples was further confirmed by sequencing, as reported in Siah <i>et al</i> (submitted). In addition, these authors identified little genetic differentiation	"In the last paragraph of the current study, Siah et al conclude, "This suggests that the circulating virus sequence types are relatively stable in western North American Pacific waters and rules out a recent introduction of PRV into the western North Pacific as suggested by Kibenge et al was instead done in the eastern north Pacific (off the western coast of Canada), not the western north Pacific. In addition, after careful reconsideration, the authors feel this conclusion is overstated. The authors would like to correct these two issues with the following revision to the final	DFO has relied on the Siah <i>et al</i> 2015 paper since 2015 for the conclusion that PRV has been long present in BC. However, Siah <i>et al</i> were forced to publish a rare correction to their paper. In that correction Siah <i>et al</i> retracted their conclusion that PRV could not be a recent introduction to BC. Further, a rare Formal Comment on Siah <i>et al</i> concluded that the evidence for PRV being a more recent introduction was more robust than the evidence for the hypothesis that PRV is native to BC.	 Has DFO reconsidered its reliance on the corrected Siah et al 2015 paper for the conclusion that PRV is not a recent introduction to BC? How does DFO address the more recent finding that the evidence for a recent introduction is more robust than the contrary hypothesis when conducting a risk assessment associated with PRV? What precautionary measures will DFO use to address the uncertainty that PRV may be a foreign virus that has recently been introduced to BC? 	
	0	DFO continues to rely on Siah et al for		

⁴⁷ http://www.dfo-mpo.gc.ca/science/aah-saa/species-especes/aq-health-sante/prv-rp-eng.html.

	DFO MISREPRESENTATION	ISREPRESENTATIONS OF SCIENTIFIC FINDINGS	
DFO Misrepresentation	Statement in Scientific Literature	'N <u>amg</u> is Comments	'Namgis Questions
over a 13 year period from a large geographical area (Alaska [US], British	paragraph.	its original conclusion and has never acknowledged the correction to it.	
Columbia [Canada] and Washington State [15]), suggesting that the	In previous study performed by Kibenge et al., the authors examined PRV		
circulating virus types are relatively	segment S1 sequences variation within British Columbia salmon and front		
Stable III the Western Holding	samples recently collected in 2012. In		
	the present study, we analyzed PRV		
	sequences obtained from samples of		
	across an expanded geographic range		
	from Alaska to Washington State over		
	13 year period. The phylogenetic		
	analysis of partial PRV S1 sequences		
	from western North America Pacific		
	Region indicated high genetic		
	homogeneity and they form a subgroup		
	within Group II. In addition, the results		
	presented here suggest that salmonids		
	from western North America Pacific		
	waters carried PRV RNA sequences for		
	differentiation among sequence types in		
	selected samples spanning 2001 to		
	2014. However, the mechanisms by		
	which the virus is globally distributed, as		
	well as transmission pathways remain		
	to be elucidated (footnotes omitted.)"48		
	"We conclude that the longer-term		
	presence of PRV in BC prior to 2001 has		
	not been adequately described and that		

⁴⁸ Siah A, Morrison DB, Fringuelli E, Savage P, Richmond Z, Johns R, et al (2016) Correction: Piscine Reovirus: Genomic and Molecular Phylogenetic Analysis from Farmed and Wild Salmonids Collected on the Canada/US Pacific Coast. PLoS ONE 11(10): e0164926. doi:10.1371/journal.pone.0164926, page 2.

	DFO MISREPRESENTATION	DFO MISREPRESENTATIONS OF SCIENTIFIC FINDINGS	
DFO Misrepresentation	Statement in Scientific Literature	'N <u>a</u> mgis Comments	'N <u>a</u> m <u>R</u> is Questions
	the evidence that the virus was introduced from Norway is more robust than the hypothesis that PRV is endemic to the eastern Pacific Ocean."		
	March 2018 Rapid	March 2018 Rapid Science Response	
"Di Cicco [2017] Importantly provided evidence that infection of farmed fish with PRV in this instance was via a marine reservoir since the fish were free of PRV upon entry into previously fallowed sea-water netpens."	"Following a four-month fallowing period, the farm was fully stocked with approximately 50–55,000 fish per pen over twelve pens in May 2013 with Atlantic Salmon smolts originating from two different hatcheries at week 17–19 of production cycle (body weight > 100 g). However, one pen received salmon in early April from another ocean production site (but still coming from one of the same hatcheries) at week 6 (body weight > 90 g) after they were transferred into the ocean. Ten fish from each of the two hatcheries underwent testing for PRV prior to the ocean transfer; all fish tested negative." The obvious next question becomes, what is the risk of this disease in Pacific salmon, and/or the risk of transmission	Despite DFO's misrepresentation to the contrary, Di Cicco (2017) did not state that the outbreak of HSMI it identified provided evidence that PRV came from the marine environment. Instead, it said that 20 (10 x 2) out of 600,000 to 660,000 fish sent to the subject fish farm tested negative for PRV before being placed in that farm. This is far too small a sample size to conclude, as DFO does, that "the fish were free of PRV". And that leaves aside that Di Cicco (2017) said nothing about the sampling methods used. Notably, DFO in the March 2018 Rapid Science Response fails to mention that that one batch of fish first went to another fish farm, where they may have become infected with PRV from that	 How does DFO address the uncertainty around whether PRV is originating in hatcheries or the marine environment? PRV originating in the hatcheries then presents a much greater risk to DFO's primary mandate to protect and conserve fish and a potential risk of irreversible harm. How does DFO plan to address this risk? How does DFO plan to ensure that the possible introduction of a foreign virus that causes disease in Pacific salmon does not cause an infringement or an extinguishment of 'Namgis' aboriginal rights and title?

⁴⁹ Kibenge MJT, Wang Y, Morton A, Routledge R, Kibenge FSB (2017) Formal comment on: Piscine reovirus: Genomic and molecular phylogenetic analysis from farmed and wild salmonids collected on the Canada/US Pacific Coast. PLoS ONE 12(11): e0188690. https://doi. org/10.1371/journal.pone.0188690, page 5.

⁵⁰ Di Cicco E, Ferguson HW, Schulze AD, Kaukinen KH, Li S, Vanderstichel R, et al (2017) Heart and skeletal muscle inflammation (HSMI) disease diagnosed on a British Columbia salmon farm through a longitudinal farm study. PLoS ONE 12(2): e0171471. doi:10.1371/journal.pone.0171471, page 10.

	DFO MISREPRESENTATION	DFO MISREPRESENTATIONS OF SCIENTIFIC FINDINGS	
DFO Misrepresentation	Statement in Scientific Literature	'N <u>a</u> mgis Comments	'Namgis Questions
	of this virus between wild salmon and farmed salmon? Risk assessment will require further studies, but PRV has been detected in most Pacific salmon species that have been tested in BC, Washington and Alaska, at lower prevalence than on farms (0–21% vs >70%)."51	farm, before being transferred to fish farm Di Cicco (2017) investigated. DFO also fails to mention that Di Cicco (2017) expressly note that prevalence of PRV on fish farms is significantly higher on fish farms (> 70%) than in the ocean (< 21%) and thus point directly to the opposite conclusion: the farmed fish were the source of the PRV.	
	June 2018 Rapid	June 2018 Rapid Science Response	
"Tissues from these fish were homogenized and injected into naïve Chinook, Sockeye and Atlantic salmon in an attempt to recreate Jaundice Syndrome in these fish. Examination of the fish after 22 weeks showed no gross or histological evidence of Jaundice Syndrome, although all of the fish tested positive for high levels of PRV."	"Among the Chinook Salmon, however, several microscopic lesions clearly separated the challenged fish from the non-injected controls. The most distinctive lesions in the challenged fish were hepatocellular cytoplasmicironrich pigment granules (87% affected, Fig. 3) and renal erythrophagocytosis (also 87% affected Fig. 4); neither of these lesions occurred among the control fish. Other lesions that affected only challenged fish – all of mild severity – included hepatocellular cytoplasmic vacuoles (33%), leuco-cytic hepatitis (33%), renal tubular cytoplasmicprote in droplets (20%), renal glomerular protein deposits (20%), myocardial karyomegaly	Despite DFO unequivocally saying that its challenge studies did not induce histological evidence of Jaundice Syndrome, the study itself expressly identified ten different types of lesions in Chinook salmon that were not present in the control group. Furthermore, during cross-examination for the recent 'Namgis judicial review, Dr. Garver confirmed that at least erythrophagocytosis lesions are symptomatic of Jaundice Syndrome, which 87% of the challenged Chinook had.	 Does DFO still plan to rely on its representation that the Garver Jaundice Study did not induce lesions after the lead author of that study as confirmed under oath that the challenged fish did have lesions symptomatic of jaundice? How does this admission and the identification of ten different types of lesions in the challenged fish in the Garver Jaundice Study change DFO's assessment of the Di Cicco 2018 paper? How does this evidence of PRV inducing ten different types of lesions in Chinook salmon inform its

⁵¹ DI CICCO E, Ferguson HW, Schulze AD, Kaukinen KH, Li S, Vanderstichel R, et al (2017) Heart and skeletal muscle inflammation (HSMI) disease diagnosed on a British Columbia salmon farm through a longitudinal farm study. PLoS ONE 12(2): e0171471. doi:10.1371/journal.pone.0171471, page 10.

DFO Misrepresentation Statem (20%) and (20%) and (20%)	Statement in Scientific Literature		
(20%) and		'Namgis Comments	'Namgis Questions
Caracacacacacacacacacacacacacacacacacaca	20%) and lymphohistiocytic		assessment of the potential adverse
occurred	endocarditis (60%). Lesions that occurred in only the control fish		impact of transferring PRV-infected fish into the marine environment on
included	included mild hepatocellular hydropic		'Namgis' Aboriginal right to harvest
mineralizi included			
confidenc	confidence intervals around control fish prevalence values are large."52		

000183

⁵² Garver, K. A., G. D. Marty, S. N. Cockburn, J. Richard, L. M. Hawley, A. Müller, R. L. Thompson, M. K. Purcell, and S. Saksida. 2015. Piscine reovirus, but not Jaundice Syndrome, was transmissible to Chinook Salmon, Oncorhynchus tshawytscha (Walbaum), Sockeye Salmon, Oncorhynchus nerka (Walbaum), and Atlantic Salmon, Salmo salar L. Journal of Fish Diseases, pages 122 to 123.

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MCCU DOCKET # / N° DU DOSSIER UCCM : 2019-001-00564	MCCU CONTACT / RESPONSABLE À L'UCCM : BARBARA MALONEY DJ	EDITOR:
REPLY BY MINO / RÉPONSE DU MINISTRE		

DATE AND DEADLINES / DATE ET ÉCHÉANCE

DUE DATE TO MINO / ÉCHÉANCE AU CM : (mm-dd-yyyy / mm-jj- aaaa)	04/02/2019	DATE RECEIVED IN MCCU / DATE DE RÉCEPTION À L'UCCM: (mm-dd-yyyy / mm-jj-aaaa)	03/05/2019
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COMMENTS	/ APPROACH -	COMMENTAIRES ,	/ APPROCHE
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DMO has indicated DM approval required.

ADDDOVALC / ADDDODATIONS

Level / Niveau	Name, Title and Sector / Nom, titre et secteur	Assigned Date / Date fixée	Date Due / Échéance	Date Approved / Date d'approbation	Changes / Modifications
2 Director	Allison Webb Director, Aquaculture Management Div., Fisheries Management Branch			March 14, 2019	Yes
Regional Director / Directeur(trice) régional(e)	Andrew Thomson Regional Director, Fisheries Management Branch			March 14, 2019	No
IF NECESSARY / SI NÉCESS	SAIRE				
Regional Director General / Directeur(trice) général régional(e)	Rebecca Reid, Regional Director General, Pacific Region			March 15, 2019	
Indigenous Affairs / Affaires autochtones	Robert Lamirande, DG, IARD	Mar. 25, 2019	Mar. 26, 2019	March 26, not approved.	Suggested edits and Legal input
		April 1, 2019	April 1, 2019	April 1, 2019	
Legal / Services juridiques					
IF / SI PROVINCIAL / TERR	ITORIAL				
DM / SM	Tim Sargent, Deputy Minister				
PCO / BCP					

OTHER CONSULTATIONS / AUTRES CONSULTATIONS

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• AE-ADMO (April 1, 2019)	Manager, Ministerial Correspondence, Pacific Region

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b.c.c. / Cci – (Name, Department / Nom, ministère)	c.c. – (Name, email address / contact info / Nom, courriel, coordonnées)
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	The state of the s	
Jonathan.Wilkinson@parl.gc.ca		
ATTACHMENTS TO RESPONSE / PIÈCES JOINTES À LA RÉPONSE		_
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Chief Don Svanvik
'Namgis First Nation

Dear Chief Svanvik:

Thank you for your correspondence of March 4, 2019, concerning the recent Federal Court decision regarding Fisheries and Oceans Canada's (DFO's) policy on Piscine Orthoreovirus (PRV).

The Federal Court required DFO to reconsider its approach of not requiring testing for PRV prior to authorizing the transfer of smolts to aquaculture facilities, and the release of smolts under the Salmonid Enhancement Policy, under Section 56 of the *Fishery (General) Regulations*. The Court suspended its judgement for four months, which means the Department must complete this review by June 4, 2019. This work is currently underway. In accordance with the findings of the Federal Court, DFO is committed to consulting with 'Namgis in reconsidering the decision not to require testing for PRV.

I appreciate your March 29, 2019, letter and accompanying affidavits, transcripts and ATIP requests. We welcome this and any further information you wish to provide us on this issue. I have asked [name], [title] in the Pacific Region, to contact you within the next weeks to engage further on this issue.

The Government of Canada will continue working with First Nations and other partners on aquaculture management, supporting wild salmon populations and their habitats, ensuring that decisions are made based on robust and rigorous science, and taking into consideration Indigenous knowledge.

Yours sincerely,

Jonathan Wilkinson, P.C., M.P. Minister of Fisheries, Oceans and the Canadian Coast Guard

From:

Lowe, Carmel

Sent:

March-05-19 8:36 AM

To:

MacDougall, Lesley

Subject:

Fw: PRV and the East Coast

Fyi

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca>

Sent: Tuesday, March 5, 2019 06:28

To: Campbell, John P.; Lowe, Carmel; Thomson, Andrew

Subject: FW: PRV and the East Coast

From: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Sent: March 1, 2019 2:14 PM

To: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca>; McPherson, Arran < Arran. McPherson@dfo-

mpo.gc.ca>

Cc: Burgetz, Ingrid < Ingrid.Burgetz@dfo-mpo.gc.ca>

Subject: PRV and the East Coast

Arran / Wayne:

PRV was first identified on the east coast a couple of years ago and we initiated some studies with aquaculture science national funding for Nellie Gagne in Gulf Region to better characterize our understanding of the distribution and prevalence of PRV in Atlantic Canada. Nellie presented some of the preliminary findings this week at our PARR Annual Meeting and the key points are summarized below. Given some of the broader discussions on emerging diseases and developing new policy approaches, these new findings should be considered in the overall context of this work.

Please let me know if there are any questions.

Thanks, Jay

Here is a summary of the situation on the east coast regarding PRV:

- The virus is highly prevalent on fish farms and in commercial hatcheries.
- Even if a farm is stocked with PRV negative smolts, fish will get PRV infected within about 9 months.
- The prevalence in commercial hatcheries is variable, and the source is unknown, but it was high in 2018. Smolts transferred to sea cages had PRV.
- HSMI, the pathology caused by PRV, has never been observed in Atlantic Canada.
- The oldest farmed fish sample we could obtain that was proper for PRV detection dates from 2001 and was positive for PRV.
- We screened wild salmons smolts from NL (4 rivers), and several hatchery raised wild salmon for stock enhancement from NB and PEI, and never found PRV.
- The PRV from Atlantic Canada is highly similar to PRV from BC (99% at the nucleotide level). Within the Atlantic Canada PRV group, we have small nucleotide variation which are usually related to geography, i.e. we can make some linkages between strain A B C D E and the farms where they were found, and the hatchery where the fish originated etc... however, these



From:

Webb, Allison

Sent:

March-05-19 9:23 AM

To:

Lowe, Carmel

Cc:

Thomson, Andrew

Subject:

RE: PRV task team mtg this am

Hi Carmel - We will be in the Raven Room, 14th Floor. See you then.

Thanks, Allison

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: Tuesday, March 5, 2019 9:22 AM

To: Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-

mpo.gc.ca>

Subject: PRV task team mtg this am

Are you planning on joining this from RHQ? If yes let me know where and I will join you.

Carmel

Sent from my BlackBerry 10 smartphone on the Rogers network.

From:

Lowe, Carmel

Sent:

March-07-19 7:06 AM

To:

MacDougall, Lesley

Subject:

Fw: CSAS on PRV

Attachments:

2019-03-05 PRV salmon FINAL release.docx

We should have a ROCS entry on this - this week.

Carmel

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca>

Sent: Thursday, March 7, 2019 03:21 **To:** Lowe, Carmel; MacDougall, Lesley

Subject: Fwd: CSAS on PRV

Fyi - not sure if you are aware or if louise g or rebecca are

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Parsons, Jay" < Jay. Parsons@dfo-mpo.gc.ca>

Date: 2019-03-06 10:01 PM (GMT-05:00)

To: "Moore, Wayne" < Wayne. Moore@dfo-mpo.gc.ca>, "Jenkins, Phil" < Phil. Jenkins@dfo-mpo.gc.ca>

Cc: "Burgetz, Ingrid" < Ingrid. Burgetz@dfo-mpo.gc.ca>

Subject: FW: CSAS on PRV

Wayne, Phil:

FYI

Please see attached a draft press release from UBC on their PRV publication that will soon be released. DFO (Science) funded this study and Kyle and Mark are co-authors.

I am not sure if DFO will be doing any comms in relationship to this as well? And if so, we should probably coordinate with UBC as I believe they are lead on this announcement.

Jay

From: Farrell, Anthony <tony.farrell@ubc.ca>
Sent: Wednesday, March 6, 2019 5:48 PM

To: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Subject: Re: CSAS on PRV

Jay

As promised, here is the news release that UBC is plan	nning for next week.
All the best	
Tony	

No information has been removed or severed from this page

DRAFT UBC NEWS RELEASE

March 13, 2019, 8:30 a.m. Journal link: https://www.frontiersin.org/articles/10.3389/fphys.2019.00114/abstract doi: 10.3389/fphys.2019.00114 Cardiorespiratory fitness of farmed Atlantic salmon unaffected by virus

Page 193 is withheld pursuant to section est retenue en vertu de l'article

68(a)

of the Access to Information Act de la Loi sur l'accès à l'information

From:

MacDougall, Lesley

Sent:

March-07-19 11:07 AM

To:

Lowe, Carmel

Subject:

FW: CSAS on PRV

Hi Carmel;

Kyle, Karen and I worked to get a proactive communications piece put together for this a few months ago, but were held off by national comms.

Since that time, it looks like Kyle was able to get support for a press release – I wasn't aware til today, and didn't know about a technical briefing.

Mark is currently working on ROCS submission -

From: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca>

Sent: March-07-19 8:43 AM

To: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Garver, Kyle <Kyle.Garver@dfo-

mpo.gc.ca>

Cc: Polinski, Mark < Mark. Polinski@dfo-mpo.gc.ca>

Subject: RE: CSAS on PRV

Kyle informed me that there will be press release next week (or week after), but yes, we (Kyle or Mark) will get some lines ready for the ROCS. Mark.

From: Moore, Wayne

Sent: March-07-19 11:33 AM

To: Lowe, Carmel

Subject: RE: Touch-base re: PRV coordination et al...?

ok

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: March 7, 2019 2:14 PM

To: Moore, Wayne <Wayne.Moore@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>;

MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-

mpo.gc.ca>; Pilcher, Scott <Scott.Pilcher@dfo-mpo.gc.ca>; Khatkar, Sunita <Sunita.Khatkar@DFO-

MPO.GC.CA>

Subject: RE: Touch-base re: PRV coordination et al...?

Wayne

I am in a WSP Roundtable with Minister all day tomorrow – would like to participate in this so suggest we find an alternate window early next week. My outlook calendar is up to date.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

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-----Original Appointment-----

From: Moore, Wayne

Sent: March 7, 2019 11:11 AM

To: Moore, Wayne; Lowe, Carmel; MacDougall, Lesley; Parsons, Jay; Pilcher, Scott; Khatkar, Sunita

Subject: Touch-base re: PRV coordination et al...?

When: March 8, 2019 2:30 PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).

Where: Telcon

Local dial-in - Numéro de téléphone local: 613-960-7513

Toll-free dial-in - Numéro de téléphone sans frais: 1-877-413-4788

Conference ID - Numéro de la conférence:

s.16(2)(c)

From:

Higgins, Mark

Sent:

March-07-19 12:08 PM

To:

MacDougall, Lesley; Lowe, Carmel

Subject:

FW: PRV Technical Briefing with UBC

We have added more info that you have requested in the ROCS below. Let me know if you need more. Mark.

From: Polinski, Mark < Mark. Polinski@dfo-mpo.gc.ca>

Sent: March-07-19 12:06 PM

To: Higgins, Mark <Mark.Higgins@dfo-mpo.gc.ca>
Subject: RE: PRV Technical Briefing with UBC

Yep, fine with me

From: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca>

Sent: Thursday, March 7, 2019 12:05 PM

To: Polinski, Mark < Mark.Polinski@dfo-mpo.gc.ca > Subject: RE: PRV Technical Briefing with UBC

I have added a sentence on the RA in the ROCS. Are you OK with this?

From: Polinski, Mark < Mark. Polinski@dfo-mpo.gc.ca >

Sent: March-07-19 11:55 AM

To: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca > Subject: RE: PRV Technical Briefing with UBC

Additions as requested. Updated version:

New Research Findings Reduce Uncertainties in the Disease Potential of the BC Strain of PRV.

Scientists in the Aquatic Animal Health Section at the Pacific Biological Station have been investigating piscine orthoreovirus (PRV) to better understand the disease causing potential and physiological consequences associated with this virus in salmon. Two papers are scheduled for release Wednesday March 13th, 2019. One paper identifies that that the PRV currently present in British Columbia has a limited capacity for causing disease in Atlantic Salmon (less so than the PRV in Norway) and that the HSMI-like disease previously reported in British Columbia could not be linked exclusively to PRV infection or transmitted to healthy fish. The second paper demonstrates no functional harm to Atlantic salmon is inflicted by high-intensity PRV infections, thereby reducing the uncertainty that PRV infections may be compromising salmon performance in the absence of acute disease. Results from these papers were fully considered in the recent CSAS Risk assessment process on PRV in Atlantic salmon farms and the effects on Fraser River sockeye salmon in the Discovery Islands area. Confidential copies were provided to all workshop participants. Media coverage is expected and Regional Science and Communications are developing updated media lines.

Dr. Kyle Garver and Dr. Mark Polinski will be available to answer media questions on these papers.

Citations:

Polinski, M. P., Marty, G. D., Snyman, H. N., and Garver, K. A. (2019) Piscine orthoreovirus demonstrates high infectivity but low virulence in Atlantic salmon of Pacific Canada. Sci. Rep., 40025. doi: 10.1038/s41598-019-40025-7

(note: GD Marty and HN Snyman are from BC Animal Health Centre, BC Ministry of Agriculture)

Zhang Y, Polinski MP, Morrison PR, Brauner CJ, Farrell AP and Garver KA (2019) High-Load Reovirus Infections Do Not Imply Physiological Impairment in Salmon. Front. Physiol. 10:114. doi: 10.3389/fphys.2019.00114

(note Y Zhang, PR Morrison, CJ Brauner and AP Farrell are from the University of British Columbia)

From: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca>

Sent: Thursday, March 7, 2019 11:37 AM

To: Polinski, Mark < Mark.Polinski@dfo-mpo.gc.ca > Subject: FW: PRV Technical Briefing with UBC

Is this alright...

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: March-07-19 11:24 AM

To: MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca >; Higgins, Mark < Mark. Higgins@dfo-

mpo.gc.ca>

Subject: RE: PRV Technical Briefing with UBC

Thanks. Note – for ROCS submissions need title and to demonstrate that given media attention is what actions we are taking.

See below and let me know if you are ok with my suggestions on these points or provide alternate suggestion. Lesley – can you connect with Louise Girouard and update media lines?

Carmel

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From: MacDougall, Lesiey <Lesiey.MacDougall@dfo-mpo.gc.ca>

Sent: March 7, 2019 11:13 AM

To: Lowe, Carmel < <u>Carmel.Lowe@dfo-mpo.gc.ca</u>>
Subject: RE: PRV Technical Briefing with UBC

Hi Carmel; I've reached out to Karen Geiger to see if I can get an understanding of who planned the technical briefing

In the meantime, Mark H and Mark Polinski have developed the following for ROCS. I think both of these papers were identified on a Tab 9, a month or so ago? We didn't have publication dates at the time.

New Research Findings Reduce Uncertainties in the Disease Potential of the BC Strain of PRV.

Scientists in the Aquatic Animal Health Section at the Pacific Biological Station have been investigating piscine orthoreovirus (PRV) to better understand the disease causing potential and physiological consequences associated with this virus in salmon. Two papers are scheduled for release Wednesday March 13th, 2019. One paper identifies that that the PRV currently present in British Columbia has a limited capacity for causing disease in Atlantic Salmon (less so than the PRV in Norway) and that the HSMI-like disease previously reported in British Columbia could not be linked exclusively to PRV infection or transmitted to healthy fish. The second paper demonstrates no functional harm to Atlantic salmon is inflicted by high-intensity PRV infections, thereby reducing the uncertainty that PRV infections may be compromising salmon performance in the absence of acute disease. Media coverage is expected and Regional Science and Communications are developing updated media lines.

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: March-07-19 11:03 AM

To: MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca >

Subject: FW: PRV Technical Briefing with UBC

See below. Is there someone you can help pull this information together quickly – should also be included in ROCS submission this week.....

Carmel

Carmel Lowe, Ph.D.
Regional Director Science | Directrice régionale des sciences
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From: Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca >

Sent: March 7, 2019 11:01 AM

To: Lowe, Carmel < <u>Carmel.Lowe@dfo-mpo.gc.ca</u>> Subject: FW: PRV Technical Briefing with UBC

You're about to get a an urgent tasking.

Andrew J L Thomson

Regional Director | Directeur régional Fisheries Management Branch | Direction de la gestion des pêches Pacific Region | Région du Pacifique Fisheries & Oceans Canada | Pêches et Océans Canada From: Fogliato, Cara On Behalf Of Reid, Rebecca

Sent: Thursday, March 7, 2019 11:00 AM To: Kaba, Kyle < Kyle.Kaba@dfo-mpo.gc.ca>

Cc: Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca >

Subject: FW: PRV Technical Briefing with UBC

Hi Kyle,

Heads up/action. I assume Johanna will follow-up with you on this as well.

Thanks,

Cara Fogliato

A/Executive Assistant to the Regional Director General/ Assistant Exécutif au Directrice Général Régional

Tel: 604-666-1376/Fax: 604-666-8956

From: Simons, Fiona

Sent: March-07-19 10:52 AM **To:** Hill, Johanna; Reid, Rebecca

Cc: McIntyre, Alexis; Lubczuk, Jocelyn; Des Rosiers, Marie-Pascale; Tran, Thi

Subject: PRV Technical Briefing with UBC

Can we please get more details about this DFO study with UBC on PRV? The Minister would like more information on this as soon as possible.

What is this study? How was it determined that there would be a technical briefing for next week? How did CP get word of a technical briefing happening tomorrow?

We've received several media questions and now have urgent and calls in from stakeholders as to why they weren't alerted about this.

Thanks,

Fiona

Fiona Simons

Pacific Desk

Office of the Minister of Fisheries, Oceans, and the Canadian Coast Guard

т.

E: Fiona.Simons@dfo-mpo.gc.ca

s.16(2)(c)

From:

Higgins, Mark

Sent:

March-07-19 12:09 PM

To:

MacDougall, Lesley; Lowe, Carmel

Subject:

FW: PRV Papers from Kyle

Attachments:

Polinski et al Author's Corrected Proof.pdf; Zhang et al. Author's Corrected Proof.pdf;

2019-03-05 PRV salmon FINAL release.docx

Papers for you information. Mark.

From: Polinski, Mark < Mark. Polinski@dfo-mpo.gc.ca>

Sent: March-07-19 12:05 PM

To: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca>

Subject: RE: PRV Papers from Kyle

There are two papers:

Polinski, M. P., Marty, G. D., Snyman, H. N., and Garver, K. A. (2019) Piscine orthoreovirus demonstrates high infectivity but low virulence in Atlantic salmon of Pacific Canada. Sci. Rep., 40025. doi: 10.1038/s41598-019-40025-7

Zhang Y, Polinski MP, Morrison PR, Brauner CJ, Farrell AP and Garver KA (2019) High-Load Reovirus Infections Do Not Imply Physiological Impairment in Salmon. Front. Physiol. 10:114. doi: 10.3389/fphys.2019.00114

The pre-print corrected proofs for both papers are attached. We are in the process of preparing plain language summaries. The UBC scheduled media release for next week is also attached.

Mark

From: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca >

Sent: Thursday, March 7, 2019 11:38 AM

To: Polinski, Mark < Mark. Polinski@dfo-mpo.gc.ca>

Subject: FW: PRV Papers from Kyle

Is this accurate?

From: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Sent: March-07-19 11:32 AM

To: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca >

Subject: FW: PRV Papers from Kyle

And more...

From: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca >

Sent: March-07-19 11:31 AM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca >; MacDougall, Lesley < Lesley.MacDougall@dfo-

mpo.gc.ca>

Subject: PRV Papers from Kyle

I understand that there is at least 1 with Tony) and possibly up to 3 papers coming out from Kyle in the coming weeks. MINO has already signalled a desire for a briefing. I have the UBC paper. Can you get me copies of the other(s)? Also, we should be preparing short plain language summaries as to what

they say and where they fit in the scheme of things. I assume at least blie of these if not more were already fuel in the RA SAR.

Heads up – I suspect the next email will be from Arran's or Rebecca's office (I am getting this through back channels).

We can discuss more tomorrow.

W.

Wayne Moore

Director General, Strategic and Regulatory Science Fisheries and Oceans Canada / Government of Canada <u>Wayne Moore@dfo-mpo.gc.ca</u> / Tel: 613-990-0001

Directeur général, Sciences stratégiques et réglementaires Pêches et Océans Canada / Gouvernement du Canada Wayne.Moore@dfo-mpo.gc.ca / Tél.: 613-990-0001

Web: <u>DFO/MPO</u>
Twitter: <u>DFO/MPO</u>

Query Details

1. Please check your article carefully, coordinate with any co-authors and enter all final edits clearly in the eproof, remembering to save frequently. Once corrections are submitted, we cannot routinely make further changes to the article.

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Author names, affiliations and emails are correct

4. Please note that after the paper has been formally accepted you can only provide amended Supplementary Information files for critical changes to the scientific content, not for style. You should clearly explain what changes have been made if you do resupply any such files.

Noted. We found an small error in Figure 2D (segment L1 and L3 were in reverse order) which required a new image file be generated. We have uploaded this file as an electronic attachement in this eproofing system and ask that Figure 2 be replaced with this new mondified Figure 2 image file. Additionally, we would like Figure 3 to be reduced by ~50% for the print (and online if possible) versions to make the sizing approriate to the text and other figures.

5. Since the references were not cited in numerical order, they have been renumbered in the order of appearance. Please check.

We have checked the References and found a number of errors. This in part appeared due to a problem with our EndNote citation manager that must have occured during the revision stage which resulted in 5 citations being inappropriately changed/ommited. We have included these references at the end of the Reference list; however, the typsetter may need to reorder the citation numbers again to reflect the final order of appearance. Note that we accidently started an unneeded new reference number which we can no longer remove from the eproof.

6. Please note we have moved the section "Ethics statement" to the end of the methods, as per house style.

Noted

e.Proofing

2/11/2019

Piscine orthoreovirus demonstrates high infectivity but low virulence in Atlantic salmon of Pacific Canada

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Mark P. Polinski, ^{1⊠}

Email Mark.Polinski@dfo-mpo.gc.ca

Gary D. Marty, ²

Heindrich N. Snyman, ²

Kyle A. Garver, ¹

- Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, V9T 6N7 Canada
- ² Animal Health Centre, Ministry of Agriculture, Abbotsford, V3G 2M3 Canada

Received: 25 July 2018 / Accepted: 4 February 2019

Abstract

Piscine orthoreovirus (PRV) is ubiquitous in farmed Atlantic salmon and sometimes associated with disease — most notably, Heart and Skeletal Muscle Inflammation (HSMI). However, PRV is also widespread in non-diseased fish, particularly in Pacific Canada, where few cases of severe heart inflammation have been documented. To better understand the mechanisms behind PRV-

associated disease, this study investigated the infection dynamics of PRV from Pacific Canada and the potential for experimental passage of putatively associated heart inflammation in Pacific-adapted Mowi-McConnell Atlantic salmon. Regardless of the PRV source (fish with or without HSMI-like heart inflammation), infections led to high-load viremia that induced only minor focal heart inflammation without significant transcriptional induction of inflammatory cytokines. Repeated screening of PRV dsRNA/ssRNA along with histopathology and gene expression analysis of host blood and heart tissues identified three distinct phases of infection: (1) early systemic dissemination and replication without host recognition; (2) peak replication, erythrocyte inclusion body formation and load-dependent host recognition; (3) long-term, high-load viral persistence with limited replication or host recognition sometimes accompanied by minor heart inflammation. These findings contrast previous challenge trials with PRV from Norway that induced severe heart inflammation and indicate that strain and/or host specific factors are necessary to initiate PRV-associated disease.

Introduction

Piscine orthoreovirus (PRV) infections of ocean-farmed salmon are widespread, and most farmed populations probably become infected at some point during a production cycle. These infections usually occur in the absence of overt disease; however, in some farming instances PRV has been associated with the development of serious disease syndromes. Specifically, a PRV subtype from Norway has been demonstrated to be the etiological agent of a disease known as Heart and Skeletal Muscle Inflammation (HSMI) of farmed Atlantic salmon (Salmo salar)[1]. This disease represents one of the most significant infectious diseases currently affecting Norwegian Atlantic salmon production[2]. Alternative PRV subtypes have also been identified in association with erythrocytic inclusion body syndrome (EIBS) in farmed Japanese Coho salmon (Oncorhynchus Oncorhynchus kisutchi)[3] as well as with an HSMI-like disease in farmed Norwegian rainbow trout (Oncorhynchus mykiss)[4]; both conditions have been associated with high morbidity/mortality in some situations.

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111

In contrast, PRV is also prevalent in many asymptomatic farmed salmon, particularly along the Pacific coast of North America, which often have high viral loads without associated lesions[5]. Indeed, despite the presence of PRV in farmed Atlantic salmon of British Columbia, Canada, for more than 30 years with presumed high prevalence during much of that time[5], heart and/or skeletal muscle inflammation has not had a significant impact to farm production[6]. Two studies have reported HSMI-like disease in Pacific Canada[7, 8] (originally reported as HSMI but we say 'HSMI-like' as PRV etiology is uncertain). However, the condition is generally rare and not all fish diagnosed with these HSMI-like lesions were infected with PRV[7] – a circumstance that has also been described previously[9]. Further, clinical presentation of disease as originally used in the case definition of HSMI as it occurs in Norway[10, 11] has never been reported in Pacific Canada.

A juxtaposition in virulence following PRV infection has also been highlighted in laboratory exposure trials. In Norway, exposure of Atlantic salmon to PRV by intraperitoneal injection, cohabitation, and anal intubation have all resulted in moderate to severe heart lesions between 4–8 weeks post challenge[1, 12]. In Canada, comparable PRV exposure trials using both intra-peritoneal injection and cohabitation have resulted in systemic PRV loads that were similar (if not greater) than those achieved in Norway, but no heart or skeletal muscle inflammation occurred during a similar time frame in either Atlantic or Sockeye (*Oncorhynchus nerka*) salmon[13]. Thus, it is currently unclear whether the HSMI-like lesions observed in Atlantic salmon of Pacific Canada are indeed HSMI; i. e., initiated primarily as a result of PRV.

One notable difference between Norwegian and Pacific Canada PRV exposure trials concerns the disease state of the donor fish from which PRV was sourced—for exposure. Where Norwegian-based experiments have used PRV collected from Atlantic salmon with HSMI, Pacific Canada studies have used virus from non-diseased fish owing to the lack of regional availability for HSMI-diseased specimens. Thus, the previous inability of PRV from Pacific Canada to cause HSMI or any other disease symptoms in Atlantic salmon following challenge might be a result of genetic differences that have rendered at least some PRV variants of Pacific Canada less virulent. The fact that PRV sequenced from Pacific Canada to date appears phylogenetically distinct relative to PRV from Norway, which encompasses multiple amino-acid substations on various genomic segments, provides evidence in support of such a hypothesis[14]. However, the HSMI-like disease reported in PRV-infected Atlantic salmon from Pacific Canada supports an

alternate hypothesis that at least one PRV variant from Pacific Canada may have caused severe heart inflammation in farmed Atlantic salmon of western North America[7, 8].

In this study, we compared PRV of Pacific Canada derived from two sources: (1) non-diseased fish and (2) fish with significant inflammation in the heart and skeletal muscle characteristic of HSMI. Our goal was to identify (i) if differences in virulence could be explained by genetic differences in the virus, and (ii) if, like in Norwegian studies, HSMI-like lesions as they hashave been recently diagnosed in Pacific Canada could be demonstrated as an infectious and transmissible disease within farmed Atlantic salmon. Further, we sought to improve upon the general understanding of PRV infection dynamics within farmed Atlantic salmon of Pacific Canada in the hope of identifying differences from Norway challenge trials that might help to explain the mechanisms for PRV virulence and pathogenesis.

Results

Preface concerning the diagnosis of HSMI

The original case definition of HSMI in Norway was founded on a set of clinical disease, gross pathology, and histological characteristics that could be differentially diagnosed from other common transmissible muscular disorders (e.g., cardiomyopathy syndrome and pancreas disease) using histopathology[10, 11]. Currently, histolopathology is still used to diagnose clinical HSMI and also to differentially diagnose subclinical cases of HSMI, cardiomyopathy syndrome (CMS) and pancreas disease (PD) in farmed Atlantic salmon of Norway[15]. Although these diagnoses are made solely upon histological evaluations, it is generally accepted that the primary agent responsible for each disease is a unique virus: PRV is the primary agent responsible for HSMI[1], piscine myocarditis virus (PMCV) is the primary agent responsible for CMS[16], and salmon alpha virus (SAV) is the primary agent responsible for PD[17]. Indeed, although environmental and/or host contributing factors may explain the often exacerbated severity of HSMI in a field relative to laboratory setting, PRV appears to be the sole infectious agent associated with the unique set of histopathological criteria that defines HSMI in Norway[1, 15, 18] and to our knowledge HSMI has never been used to classify a disease state in Norway where PRV has been confirmed to be absent.

Two recent studies from Pacific Canada have also used the term HSMI to classify subclinical heart disease of farmed Atlantic salmon based on histopathology in accordance with their own definitions that are similar to those previously reported

in Norway – namely, moderate to severe heart inflammation sometimes accompanied by skeletal muscle inflammation[7, 8]. Although the presumed commonality for the heart and skeletal muscle lesions in these Canadian studies relative to HSMI diagnosed in Norway is the causation by PRV, there is far less evidence in Canada to support that PRV is indeed the key component for initiating this disease state. Particularly given that these modified definitions based on heart pathology alone have occasionally been observed in the absence of PRV[5, 7]. Consequently, if HSMI diagnosis is based solely on histopathological heart lesions which can occur in the absence of PRV, then PRV cannot be assumed to be *the* causative agent of the disease, but rather one of multiple stand-alone or synergistic putative factors.

For this study, we reserve the designation of HSMI in field environments to cases as defined by Wiik-Nielsen and colleagues[15] – presence of cellular epicarditis; moderate-to-severe inflammation and necrosis especially in the ventricle (inflammation predominant); inflammation of the red skeletal muscle a supportive finding – for which PRV is the likely primary etiologic agent. We use the term HSMI-like for cases which fit the definition of HSMI as presented above but have questionable etiology, and use the term idiopathic cardiopathy in all other instances of heart associated pathology for which PRV may or may not be a contributing cause. In a laboratory setting where external factors are controlled, we adopt the modified diagnosis of HSMI previously used in assessing most experimental challenge trials in Norway; namely, histological visualization of moderate to severe heart inflammation that may or may not be accompanied by skeletal muscle inflammation but is clearly associated with a PRV infection, e.g., absent from the control population[1, 19, 20, 21, 22].

Case Report for HSMI-like disease in farmed Atlantic salmon of Pacific Canada

Idiopathic cardiopathy of a severity to cause morbidity or death (for which putative HSMI or HSMI-like lesions would be encompassed as a subset) is uncommon among British Columbia farmed Atlantic salmon and has historically been diagnosed in 1–3% of surveillance samples taken from moribund or recently deceased fish on farm sites since the early 1990s[23, 24, 25, 26]. More recently, Fisheries and Oceans Canada Aquaculture Management Division conducts a regulatory Fish Health Auditing and Surveillance Program that from 2014–2017 sampled 2,960 moribund or recently deceased farmed Atlantic salmon for histopathology (https://open.canada.ca). These fish were collected during 407 audits of Atlantic salmon marine farms. Various types of idiopathic cardiopathy

were diagnosed as a cause or marker of death in 62 (2.1%) of the sampled fish, and one of these fish (0.03% of 2,960) also had moderate skeletal muscle inflammation. Although some of the idiopathic cardiopathy observed in these samples (as well in samples from the early 1990s) might represent HSMI caused by PRV, a definitive diagnosis of HSMI is impossible to provide with any degree of certainty in these isolated occurrences.

However, on July 5th, 2016, microscopic lesions consistent with the recent diagnosis of HSMI in Pacific Canada[8] were identified during a pre-transfer government audit of an Atlantic salmon sea-pen cohort in the Johnstone Strait off the eastern coast of Vancouver Island. Of the 40 fish sampled, 11 (28%) had inflammatory heart lesions within the atrium and ventricle that were moderate (10 fish) to severe (1 fish); two fish (5%) also had moderate inflammation within the red skeletal muscle. Between July 29th and August 7th, 2016, 5 of 11 fish (45%) from the same farm were also diagnosed with moderate to severe heart inflammation characteristic of HSMI, although these samples did not have skeletal muscle inflammation. In a final sampling taken specifically for this study on August 19th, 2016, 3 of 20 fish (15%) had moderate to severe heart inflammation (but no moderate or severe skeletal muscle inflammation) and all 20 were qPCR positive for PRV L1 RNA with a mean load of 9.0e⁸[8] (±6.9e⁸[8] SEM) reverse transcribed copies per mL blood. The pathologists (HNS and GDM) who initially assessed these samples, although blinded to PRV status, reported that the lesions were similar to descriptions of HSMI as it is currently diagnosed in Norway, which was confirmed by a third pathologist (Renate Johansen; Pharmaq Analytiq, Bergen Norway) with long experience diagnosing HSMI in farmed Atlantic salmon in Norway. A summary for the histopathology scoring of heart and muscle tissues from all three pathologists was highly comparable (Supplement 1).

All fish on the affected site were progeny of North America-adapted Mowi-McConnell brood stock[27] and had been reared in a single freshwater facility on Vancouver Island, Canada. Fish were presumed to be PRV-free upon seawater entry because virus was not detected by qPCR within a companion cohort from the same freshwater hatchery where these fish were sourced (n = 20). The first sampling and diagnosis of HSMI-like lesions was 2–3 months post seawater entry. At sea, and specific to the farm and period where the lesions were diagnosed, the site veterinarian reports that the population did not have clinical signs of disease. Total farm monthly mortality (all causes) was between 0.2–0.5%, which is below the industry average of ~0.83%, and feeding behavior was normal with mean growth rates in accordance with company-targeted projections.

PRV from Atlantic salmon with and without HSMI-like lesions generate extensive and persistent infections in naïve recipients

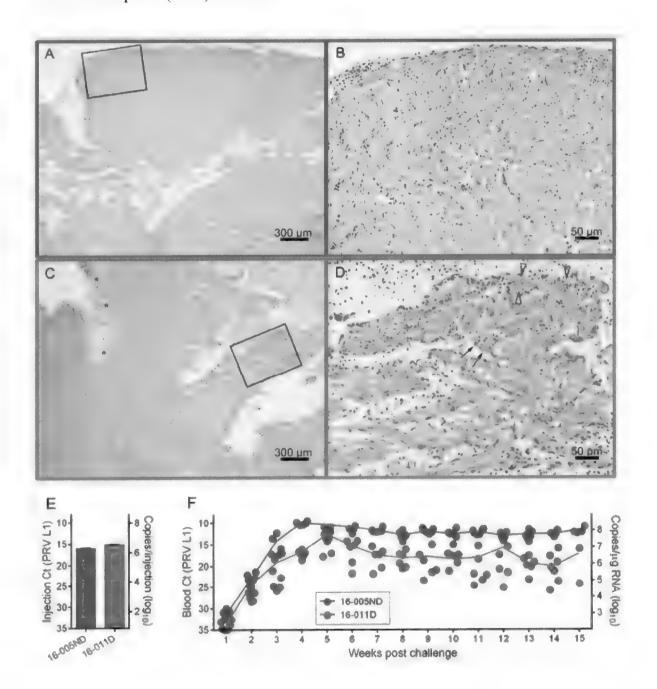
Naïve juvenile Atlantic salmon originating from the same brood stock and rearing facility as the fish with HSMI-like lesions described above were exposed in parallel under controlled laboratory conditions to PRV from one of two sources: (1) three fish with HSMI-like heart lesions collected August 19th described above (designated 16-011D), and (2) three non-diseased fish infected by experimental challenge with PRV originating from an alternate freshwater facility with at least a three year history of PRV presence without documentation of heart or muscle inflammation; this PRV had not generated HSMI in previous laboratory challenge trials[13, 28] (designated 16-005ND; see Methods section).

Following intra-peritoneal (i.p.) injection of similar quantities of PRV, virus replication dynamics were slightly different for the two PRV inoculates. The total quantity of PRV L1 copies per injection was 2.0e⁶[6] for 16-005ND and 3.7e⁶[6] for 16-011D (determined by TagMan qPCR; Fig. 1E) and both inoculates generated substantial systemic infections. However, PRV 16-005ND rapidly disseminated and replicated to peak transcriptional loads by four weeks post challenge (wpc) with 2.9e⁸[8] mean PRV L1 copies per ug RNA (Fig. 1F). This was estimated at >1.0e¹¹[11] copies per mL blood based on the total RNA yield per 100 μL blood sample. After 4 wpc, systemic PRV transcripts decreased but remained substantial, with a mean load of 6.8e⁷[7] copies per μg RNA (>2.0e¹⁰[10] copies per mL blood) between 10-to-15 wpc. In contrast, infection with PRV 16-011D was slower to develop, with peak loads not occurring until 5 wpc and to a fivefold lesser degree (mean quantity of 6.0e⁷[7] PRV L1 copies per ug RNA) than observed for PRV 16-005ND. Further, although the PRV 16-011D challenge generated large quantities of virus with persistent high-load systemic infections – 3.2e⁶[6] mean copies per μg RNA, representing >1.3e⁹ copies per mL blood between 10-15 wpc - this persistent load was only about 5% of PRV 16-005ND.

Figure 1

PRV from Atlantic salmon with and without HSMI-like lesions generate extensive and persistent infections in naïve recipients. (A,B) PRV was obtained from the blood of donor fish without heart lesions (16-005ND) or (C,D) with HSMI-like lesions (16-011D). Lesions in diseased fish included epicarditis (*), endocardial cell hypertrophy (arrows) and small foci of myocardial necrosis (open arrowheads). Black boxes within left images outline the area shown at higher magnification in right images. (E) The quantity of PRV L1 transcripts of PRV 16-005ND and 16-011D inoculated into each naïve recipient was estimated by qPCR, and (F) the systemic blood load of PRV

L1 transcripts was assessed every 7 days in recipient fish (n = 6 per treatment where available). The unique relative qPCR threshold cycle (Ct) associated with each sample (dots) as well as the mean estimated quantity of L1 copies per μ g total RNA at each time point (lines) are shown.



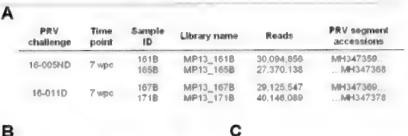
PRV sourced from cohorts with and without HSMI-like lesions have high sequence similarity

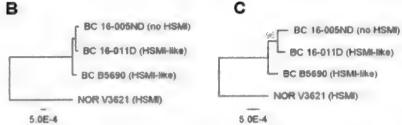
RNA extracted and purified from the blood of both PRV 16-005ND and 16-011D challenged fish at 7 wpc (n = 2 per treatment) waswere subjected to next-generation RNA-sequencing (RNA-seq) to independently obtain the genomic sequences of

PRV 16-005ND and 16-011D. Following rRNA depletion and Illumina sequencing, 27-40 million reads with Phred scores >33 were generated from the RNA of each fish and deposited in the NCBI Sequence Read Archive, study SRP145317. Individual SRA library accession numbers are provided in Fig. 2A. Libraries specific to either 16-005ND or 16-011D were pooled for de novo transcript assembly using Trinity[29] which identified all 10 genomic segment of PRV for both isolates. The longest Trinity assembled PRV transcripts segments were deposited in Genbank; accession MH347359 - MH347378 (Fig. 2A). De novo assembled transcripts had 98.5% (16-005ND) and 98.9% (16-011D) concatenated coverage across all segments with respect to two previously published PRV genomes – one isolated from diseased Atlantic salmon in British Columbia during the first reported outbreak of HSMI in the region (isolate B5690)[8], the other from HSMI diseased Atlantic salmon in Norway which was used to demonstrate laboratory passage of HSMI and the causal relationship of PRV in HSMI disease within Norway (NOR2012-V3621)[1]. This coverage incorporated 99.5% (16-005ND) and 100% (16-011D) of the protein coding sequence presented in for these two published genomes where the only notable loss in coverage was the putative 128 bp (41 aa) missing 5' end of the L13 segment for 16-005ND.

Figure 2 In this version of Fig. 2D, there is a mix up - Lambda 3 and Lambda 1 are reversed. Please use the new Fig. 2 attached where we have corrected this is tyo.

PRV sourced from cohorts with and without HSMI-like lesions have high sequence similarity. (A) RNA-seq read libraries (n = 4) were pooled specific to PRV source material (n = 2) and assembled *de novo* using Trinity. (B) Concatenated PRV segments are phylogenetically compared to two previously published genomes of PRV (Pacific Canada isolate B5690[8] and Norway isolate V3621[64][1]). Bootstrap probabilities (percentages) are provided at branch nodes if less than 100%; scale bar indicates nucleotide substitutions per site. (C) Predicted amino acid sequences are compared in the same manner as nucleotide sequences. (D) The comparative identity between nucleotide (nt) and predicted amino acid (aa) sequences as well as the number of substitutions () per alignment are provided in relation to 16-005ND. Substitutions unique to either 16-005ND (no HSMI) or V3621 (only Norwegian isolate; HSMI) are also indicated.





D	16-0	05ND identity v	rersus:	Uniqu	e sites
Sequence (nt followed by an)	16-011D	₩5690	V3621	16- 005ND	V3621
L1 Lambda 3	100% (0)	99 95% (2) 99.92% (1)	99.31% (27) 100% (0)	0	26 0
Lambda 2	99.97% (1) 99.92% (1)	99.85% (6) 99.84% (2)	99.57% (17) 99.77% (3)	0	12
L3 Lambda 1	99.97% (1)	99.97% (1) 100% (0)	99.28% (27) 100% (0)	1 0	26 0
Mt 1 Mu 2	99.96% (1) 100% (0)	99.85% (4) 99.87% (1)	99.15% (20) 100% (0)	1 0	19
M2 Mu 1	100% (0)	99.95% (1) 99.85% (1)	99.15% (67) 99.56% (3)	0	67 3
M3 Muns	99.87% (3) 99.87% (1)	99 92% (1) 99.87% (1)	98.53% (34) 99.60% (3)	1	33 2
Sigma 3 P13	99.81% (2) 99.39% (2) 100% (0)	99.81% (2) 99.39% (2) 100% (0)	98.61% (36) 96.36% (12) 92.74% (9)	2 2 0	34 10 9
Sigma 2	99.92% (1) 100% (0)	99.69% (4) 100% (0)	98.62% (18) 99.52% (2)	1 0	15 2
\$3 SigmaNS	100% (0) 100% (0)	100% (0) 100% (0)	98.93% (12) 100% (0)	0	12 0
Sigma 1	99.90% (1) 99.68% (1)	99.90% (1) 99.68% (1)	99.71% (3) 99.68% (1)	0	0
Concatenated (nt) Concatenated (sa)	99 96% (10) 99.93% (5)	99 91% (22) 99.88% (9)	98.86% (261) 99.56% (33)	6	245 27

Genomic sequences of 16-005ND and 16-011D have 99.96% nucleotide identity with only 10 nucleotide substitutions within over the approximate 23 kb concatenated genomes. Both isolates are also highly similar (>99.9% nucleotide identity) to the B5690 isolate previously identified in BC, but are comparatively divergent (~98.9% nucleotide identity) to the Norwegian V3621 isolate (Fig. 2B–D). This pattern of divergence is similarly reflected in predicted protein translation. Specifically, V3621 has 245 unique nucleotide substitutions that results in 27 predicted amino acid changes relative to the three Canadian isolates considered in this study-across the concatenated genome, with the highest proportion of translational variation being associated with the bicistronic S1 segment (Fig. 2D).

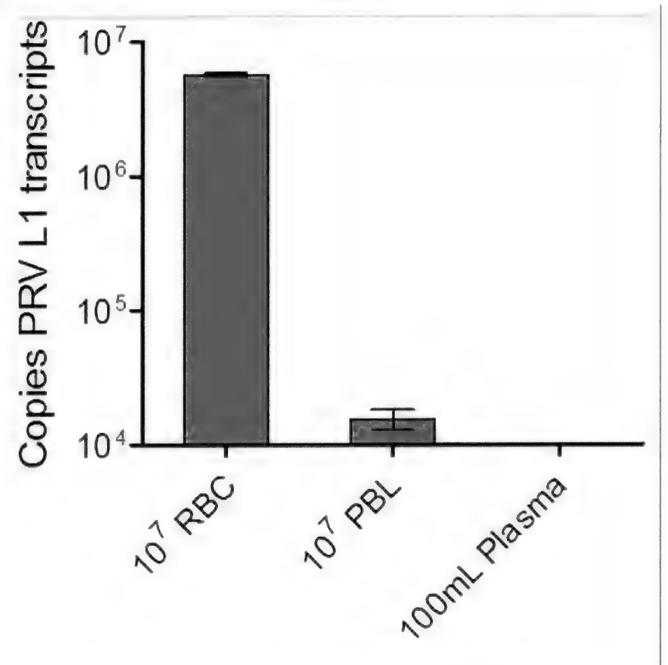
However, only six nucleotide substitutions (resulting in 3 predicted amino acid substitutions) are unique to Pacific Canada PRV sourced from non-diseased Atlantic salmon (16-005ND) compared to two isolates from HSMI diseased fish in Norway and fish with HSMI-like lesions in Pacific Canada. All three of these putative amino acid substitutions (one from MuNS, two from Sigma 3) are predicted to alter protein secondary structure as identified by the EMBOSS 6.5.7 garnier plugin within Geneious 9.1.7 software. The MuNS substitution is predicted to eliminate a coil at position 386 thereby extending an alpha helix. The substitution at position 180 of Sigma 3 results in the same alteration, whereas the substitution at position 230 of Sigma 3 results in the predicted shortening of a beta-strand and lengthening the subsequent alpha helix. These structural changes are predicted with approximately 65% accuracy and the consequences (if any) for these changes in secondary structure or putative protein function are unknown.

Systemic PRV load is associated with erythrocytes and not detectable in plasma

At 10 wpc, a portion of blood collected from three 16-005ND PRV infected fish was separated into plasma, leukocyte, and erythrocyte fractions. By qPCR screening, virtually all PRV L1 transcripts were associated with the erythrocyte fraction during this laterpersistent phase of infection (Fig. 3). Further, PRV L1 RNA was not detected in (i) plasma (limit of detection of approximately 30 copies per 100 µL-plasma screened) at the 10 wpc time point or (ii) from the plasma of any PRV-challenged fish (both 16-005ND and 16-011D) collected across all sampling time points.

Figure 3 This figure was not intended to be this large relative to the text or the other figures. Please reduce the image size by \sim 50% for final publication. We can provide a smaller image if nessisary.

Systemic blood PRV load is associated with erythrocytes and not detectable in plasma. Copy number of PRV L1 transcripts at 10 weeks post PRV 16-005ND challenge (n=3) was high within the erythrocyte red blood cell (RBC) fraction, low within the peripheral blood leukocyte (PBL) fraction, and not detectable in plasma.



The relative proportion of PRV genomic and messenger RNA in erythrocytes changes over the time course of infection

Reoviruses have a dsRNA genome which is asynchronously transcribed. Positive-strand RNA is synthesized first which acts as mRNA template for viral protein translation and template for subsequent minus-strand synthesis of genomic material (gRNA)[30]. To better understand the timing and degree of PRV protein production versus gRNA synthesis, we developed a new method to differentially quantify PRV single-stranded (mRNA) and double-stranded (gRNA) RNA using qPCR. Because recombinant reverse transcriptases such as MultiScribeTM selectively target ssRNAs

during cDNA synthesis, we hypothesized that PRV dsRNA segments would not be detected by qPCR unless they were denatured into single-strands prior to reverse transcription of cDNA and that this would require temperatures above 90 °C based on sequence-specific melting point estimations

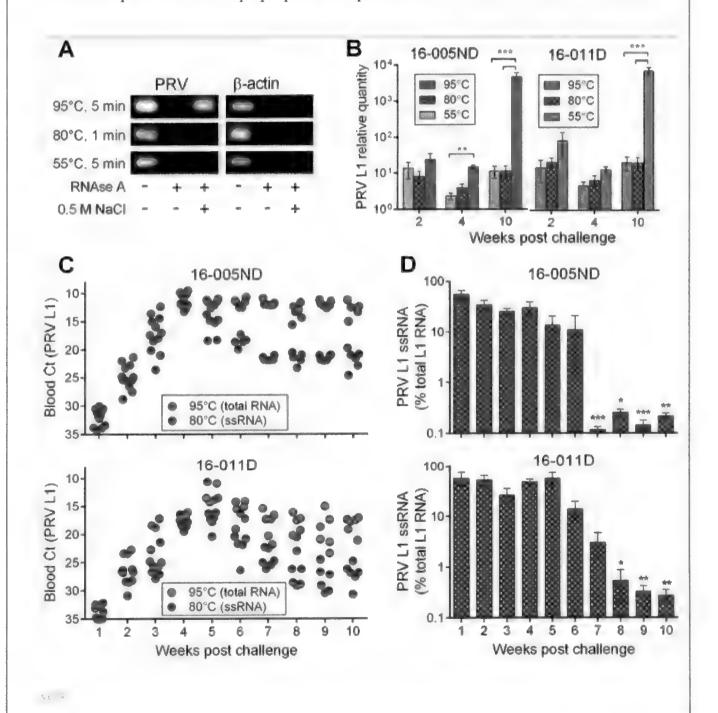
(http://www.endmemo.com/bio/tm.php). By this reasoning, exposure to low temperatures (i.e., below 90 °C) for the removal of secondary structure prior to reverse transcription would result in only single-stranded PRV (mRNA) detection by qPCR. Experimental testing confirmed this hypothesis to be correct, as the dsRNA genomic component was only measureable in those samples denatured at 95 °C and not following exposure to either 55 or 80 °C (Fig. 4A). Capitalizing on the ability to differentiate mRNA vs gRNA via differential temperature screening regimes, we analyzed early (2 wpc), peak (4 wpc), and late (10 wpc) stages of PRV infection to compare relative transcription of mRNA and gRNA. Utilizing two temperatures (55° and 80 °C) below the threshold needed to denature dsRNA, the relative proportional quantity of PRV L1 ssRNA transcripts was not significantly different at either temperature across all three time points. Yet, when measuring both mRNA and gRNA in the denatured samples (95 °C), the fraction of the gRNA differed significantly dependent upon sample time point. At 2 and 4 wpc the ssRNA component constituted approximately 50 (± 40)% of the total RNA while at 10 wpc the ssRNA component was significantly reduced, to-only representing 0.1 to-0.7% of the total PRV RNA load with gRNA accounting for the vast majority (Fig. 4B). Subsequent targeting of total and ssRNA PRV L1 transcripts in all blood samples collected between 1 and 10 wpc confirmed that during early and peak replication, single-stranded mRNA typically represented 10-90% of the total PRV transcriptional load; but, after approximately 5-6 wpc, the quantity of singlestranded mRNA quickly became proportionally less. By 7-8 wpc, PRV ssRNA represented only 0.1–1.0% of the total systemic transcriptional load which was significantly less than during early (1wpc) infection (Fig. 4C,D). This pattern of expression was strikingly similar following challenge with either PRV 16-005ND or 16-011D.

Figure 4

The relative proportion of PRV genomic and messenger RNA in blood changes over the time course of infection. (A) RNA from PRV 16-005ND infected fish at 10 wpc was used to validate differential detection of PRV L1 ssRNA (mRNA) and dsRNA (gRNA) transcripts by qPCR. Total RNA exposed to either no enzyme, RNAse A, or RNAse A in 0.5 M sodium chloride (which selectively protects dsRNA but not ssRNA from RNAse A degradation[60]) was heated at 55 °C for 5 min, 80 °C for 1 min, or 95 °C for 5 min prior to reverse transcription and 30-cycles of qPCR. PRV

after 7-8 wpc relative to 1wpc proportional quantities.

dsRNA template was only present following 95 °C denaturation as seen in cropped gel images relative to host β -actin ssRNA (for Ct values see Supplement 1). (B) The relative quantities (scaled to the minimum value per time point) of PRV L1 at 2, 4, and 10 wpc for both PRV 16-005ND and 16-011D are compared between pre-amplification denaturation temperatures. The proportion of dsRNA to ssRNA significantly increased at 10 wpc in both PRV challenged groups (*p < 0.05; **p < 0.01, ***p < 0.001). (C) The shift toward higher proportions of PRV dsRNA in blood began around 5-6 wpc; (D) where the amount of ssRNA became significantly reduced

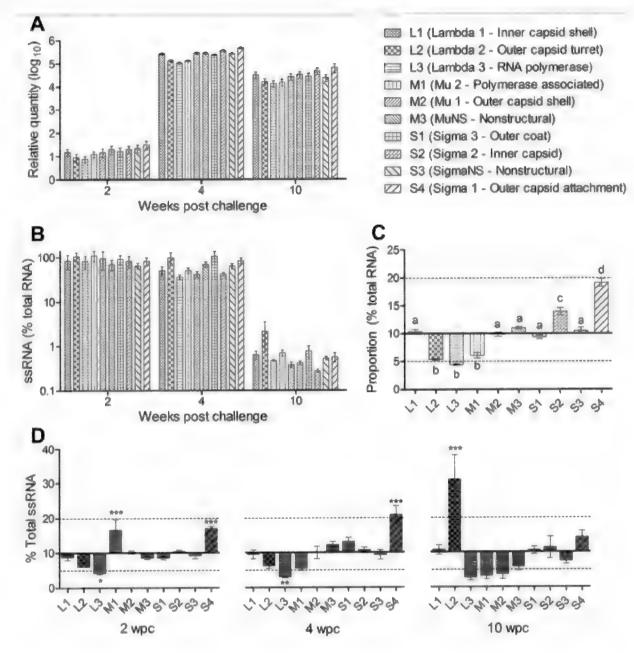


Expression of PRV segments is temporally similar but with slight proportional variation

To compare and contrast the relative load for each of the 10 PRV genomic segments following experimental infection, SYBRTM green qPCR assays were designed against each of the 10 genomic segments of PRV and used to assess relative quantities of each segment in the blood of PRV 16-005ND challenged fish at early (2 wpc), peak (4 wpc) and persistent (10 wpc) phases of infection. This identified that relative quantities of all 10 segments of PRV 16-005ND were not significantly different at any of the three time points analyzed even though the total systemic PRV RNA load encompassed an approximate $10e^4$ fold change in systemic load over this time (Fig. 5A); indicating the proportion of total PRV RNA represented by each segment was conserved during all three infection stages. However, the proportion of each segment contributing to the total PRV RNA independent of time was not equal; this variation was less than twofold but statistically significant (p < 0.05). Specifically, L2, L3 and M1 were proportionally underrepresented whereas S1 and particularly S4 were overrepresented relative to the other segments (Fig. 5C).

Figure 5

Expression of PRV segments in host blood is temporally similar but with slight proportional variation. (A) The relative quantity (scaled to the minimum value) of each PRV RNA segment in the blood of 16-005ND challenged fish waswere statistically similar at 2, 4 or 10 wpc. (B) The single-stranded mRNA contribution to total PRV load was also similar between segments at each time point. However, (C) the cumulative proportional contribution of L2, L3, and M1 was significantly less, whereas S2 and S4 was significantly more, relative to all other segments independent of time (letters indicate significant groupings at p < 0.05). (D) Total proportional contributions of total single-stranded mRNA expression also varied between segments, but was not consistent over time points (*p < 0.05; **p < 0.01; ***p < 0.001). Dotted lines at 5 and 20% provide reference of a twofold deviation away from complete proportional equality (10%).



Selective ssRNA targeting techniques previously validated for L1 were also applied to each of the other 9 segments in this dataset. In a similar pattern to L1 transcription, the ssRNA component of all 10 PRV segments was relatively high (\sim 10–90%) during early and peak infection but became reduced (nearly all < 1%) following the transition to late-stage persistent infections (Fig. 5B). Nevertheless, significant proportional variation in ssRNA quantity occurred for some segments over the course of infection. In comparison to segment L1 ssRNA, which maintained stable expression across all three time points (mean 9.7% \pm 0.7 SEM of total ssRNA), segment L3 ssRNA was proportionally decreased whereas segment S4 was proportionally increased during early and peak infection. Segment M1

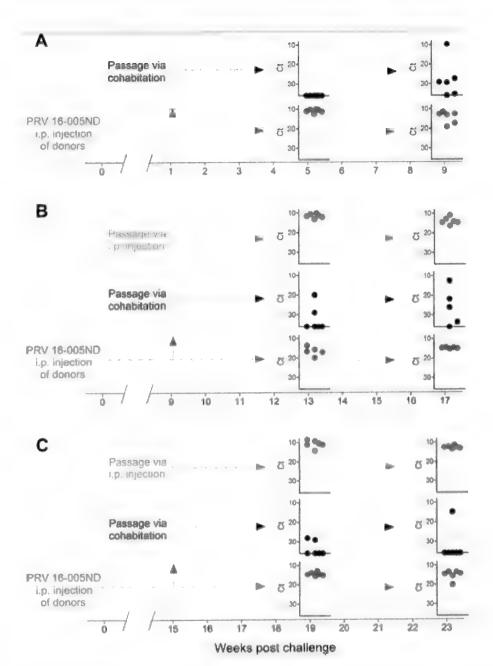
ssRNA was also proportionally increased during early infection, whereas segment L2 ssRNA only became proportionally increased during the late persistent phase (Fig. 5D). L1, M2, M3, S1, S2 and S3 maintained relatively stable proportional ssRNA expression across all three time points; and even though L2, L3, M1 and S4 had significant proportional variation compared to the other stable segments, their variation was mostly encompassed within a twofold change relative to complete segment equality (10% each).

Persistent late-stage PRV infections remain highly infectious by i.p. injection but have reduced ability for infecting naïve cohabitants

The limited quantities of PRV single stranded mRNA at 10 wpc indicated that viral replication had become substantially reduced. To determine the transmission potential of PRV during different stages of infection, we initiated a third challenge trial where three groups of naïve fish (n = 15 per group) were injected with PRV 16-005ND from which viral passage was attempted by either cohabitation (1:1 shedder to naïve fish ratio) or by i.p. injection (100 uL blood homogenate diluted 1:10 in saline) to naïve recipients introduced at either 1, 9, or 15 weeks post challenge (Fig. 6). Fish injected with PRV 16-005ND had PRV infection dynamics similar to those observed in the first challenge. Viral loads were high at 5 wpc (6.2e⁷[7] mean copies per µg RNA), were slightly less at 9 wpc, and stabilized at reduced but still substantial loads at 13, 17, 19 and 23 wpc (4.9e⁶[6] mean copies per μg RNA). Passage of virus to cohabitants introduced soon after the primary injection exposure (1wpc) provides evidence that natural shedding might be minimal in this early period of infection as PRV L1 RNA could not be detected in sentinel fish after 4 weeks of cohabitation. Even after 8 weeks of cohabitation, when 5 of the 6 sampled fish were positive for PRV L1 RNA, the systemic loads were still relatively low (<1e³[3] copies per μg RNA) in all but one fish (Fig. 6A); suggesting an early stage of dissemination.

Figure 6

Persistent late-stage PRV blood infections remain highly infectious by i.p. injection but have reduced ability for infecting naïve cohabitants. Passage of PRV 16-005ND from i.p. injected donor fish into naïve recipients by either i.p. injection or cohabitation was attempted at (A) 1, (B) 9, and (C) 15 wpc. After a period of 4 or 8 weeks following each attempted passage, blood of both recipients and donor fish (n = 6 per group) was screened for total PRV L1 transcripts by qPCR. The unique relative qPCR threshold cycle (Ct) associated with each sample is presented. Samples plotted on x-axes indicate a lack of detection for PRV L1 transcripts in each instance (no Ct).



PRV passage via cohabitation was successful during late stage infections. At least a portion of naïve cohabitants introduced at either 9 or 15 wpc became infected during 8 weeks of cohabitation (Fig. 6B,C). However, these infections tended to be slow to develop and more fish became infected when introduced at 9 wpc (7/12) than when introduced at 15 wpc (3/12). This might be a result of less infectious virus being shed in chronically infected fish than from fish at or near peak infection. Nevertheless, passage of virus during this late persistent phase was readily accomplished via i.p. injection of blood homogenate into naïve recipients which generated high-load systemic infections in 100% of fish within 4 wpc.

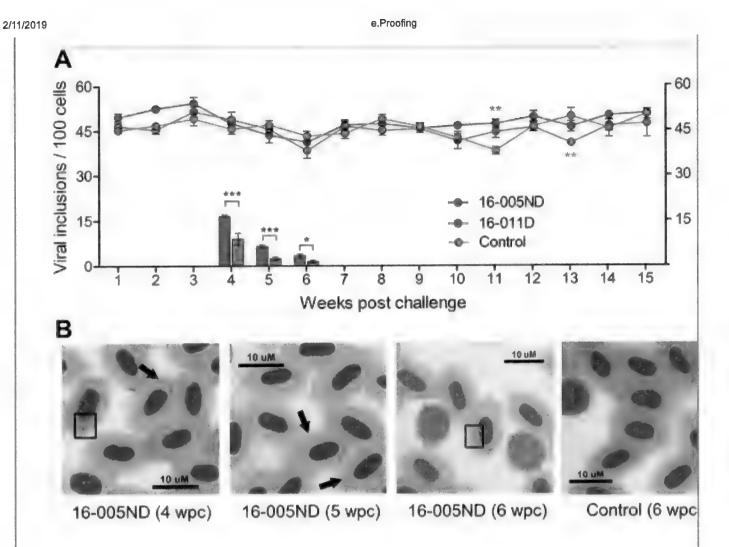
Indeed, injection of this late-stage material into naive recipients yielded infection dynamics nearly identical to the first challenge with PRV 16-005ND, which had been harvested for passage at 4 wpc just when peak loads had been reached (Fig. 6B,C).

PRV sourced from cohorts with and without HSMI-like lesions cause transient erythrocytic inclusions but not anemia in naïve recipients

Despite PRV reaching extreme (>10⁹ PRV L1 copies per mL) systemic blood loads following PRV 16-005ND and 16-011D injection challenges-that were almost exclusively associated with erythrocytes, neither PRV 16-005ND nor 16-011D caused a notable reduction in hematocrit (Fig. 7A). Relative to time matched controls, significant differences in hematocrit were uncommon (two sample setsone occasion during each challenge) and inconsistent. Hematocrit was greater at 11 wpc in the PRV 16-005ND challenged group and less at 13 wpc in the PRV 16-011D challenged group and, in both instances, did not deviate beyond the range of control fish (38–50%). where aAll values were well above an approximate 25% hematocrit threshold previously estimated to represent functional anemia in salmon[31].

Figure 7

PRV sourced from blood of cohorts with and without HSMI-like lesions cause transient erythrocytic inclusions but not anemia in naïve recipients. (A) The trend in mean (\pm SEM) hematocrit (lines) for both PRV 16-005ND and 16-011D challenged fish in comparison to time-matched experimental controls did not suggest anemia in any treatment group. Erythrocytes with viral inclusions (bars) were observed between 4 and 6 wpc and were more prevalent in 16-005ND challenged fish (*p < 0.05; **p < 0.01; ***p < 0.001). \mp .(B) Erythrocyte cytoplasmic inclusions were defined as either a single, large spherical body (arrows) or as a cluster of smaller globular bodies (boxed) with moderate to dark staining.



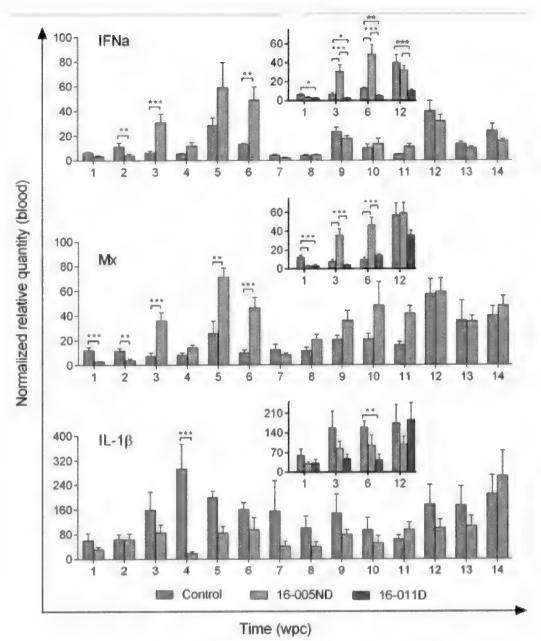
Transient viral inclusion bodies were observed by pinacyanol chloride staining between four and six weeks post challenge in blood smears of both PRV 16-005ND and 16-011D infected fish. Up to 15% of erythrocytes had inclusions and fish challenged with PRV 16-005ND had slightly higher quantities compared to those infected with 16-011D (Fig. 7A). Single, large spherical viral inclusions occurred at 4, 5, and 6 wpc; however, at 4 wpc when inclusions were first identified, affected erythrocytes from both challenge groups also had high prevalence of clusters of smaller inclusions. These primarily occurred in darkly stained (presumably immature) erythrocytes (Fig. 7B). At 5 wpc, large spherical inclusions predominated. By 6 wpc, inclusions appeared to be breaking up, as clusters of smaller inclusions again became dominant. No viral inclusions were observed at any other time point during these challenge trials.

Systemic host transcriptional responses against PRV are minor, transient, and possibly load dependent

To identify if and when PRV is recognized by host blood cells, transcription of two classic viral recognition/antiviral defense genes were monitored during the PRV challenge trials: (i) IFNa, a type-I interferon of salmon which is generated in response to viral recognition in nearly all cell types [32], and (ii) Mx, an antiviral response element triggered by cellular recognition of interferon[33]. Both genes were transcriptionally down-regulated during early infection (1-2 wpc) in both PRV 16-005ND and 16-011D infected fish relative to time-matched controls; however, as PRV infections progressed, significant induction of both IFNa and Mx occurred in 16-005ND but not 16-011D challenged fish (approximately 4-5 fold) when virus reached at or near peak loads (3-and-6 wpc) (Fig. 8). Neither IFNa nor Mx transcription was significantly up-regulated following 16-011D challenge at any of the time points analyzed. The lower systemic viral loads generated during peak 16-011D infection provides evidence that the response observed in 16-005ND was possibly load dependent. No significant change in IFNa or Mx transcriptional expression occurred during the late stages of PRV infection (7-15 wpc) in either 16-005ND or 16-011D challenges relative to time-matched controls. Further, monitoring of *IL-1* transcription, an important cytokine involved in the inflammatory process of vertebrate and non-vertebrate animals including salmon[34], also did not demonstrate significant systemic induction in blood of either PRV 16-005ND or 16-011D infected fish at any time point following challenge (Fig. 8). Rather, if any change occurred, it appeared that IL-1\beta transcription was slightly reduced in some instances relative to controls.

Figure 8

Systemic host transcriptional responses in blood against PRV are minor, transient, and possibly load dependent. The gene expression of *IFNa*, Mx, and IL- 1β (proteins involved in viral response, antiviral, and inflammatory pathways, respectively) were monitored in 16-005ND challenged and control fish at weekly intervals and in 16-011D challenged fish at 1, 3, 6, and 12 wpc (see insert graphs). Significant (*p < 0.05; **p < 0.01; ***p < 0.001) increased expression from time-matched controls of *IFNa* and Mx but not IL- 1β occurred when PRV 16-005ND load was near its peak (3-6 wpc). In each instance, expression was normalized to the stable expression of β -actin and scaled to the minimum observed value.



Minor heart inflammation occurs during persistent late-stage PRV infections independent of donor fish disease status

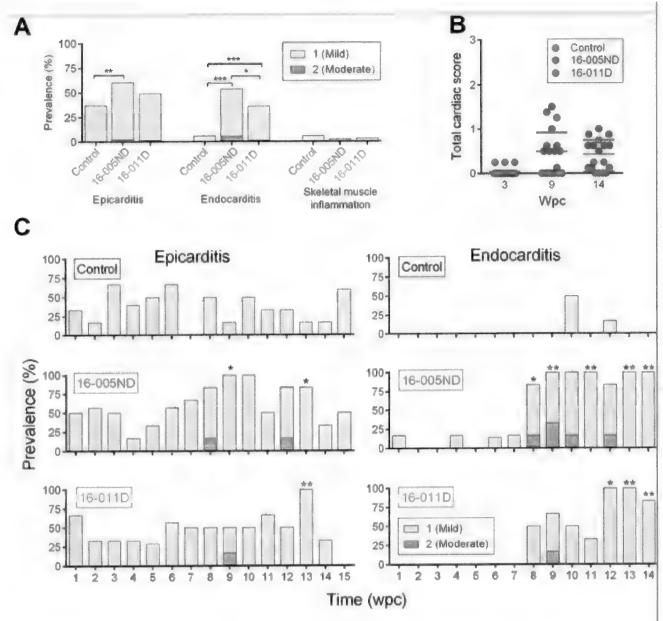
All heart and as well as red and white skeletal muscle samples collected during this study were examined by pathologists GDM and/or HNS. with aA subset collected at 3, 9 and 14 wpc were also evaluated by a reviewing pathologist (Renate Johansen, Pharmaq Analytiq). In all instances, pathologists were blinded to PRV exposure status and lesions were scored according to severity (0 – none, 1 – mild/small amount, 2 – moderate, or 3 – severe/abundant) similar to methods applied in previous HSMI studies[1, 8, 22, 35] (Supplement 1). Mild lymphohistiocytic

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epicarditis was common in hearts of control fish during this study with a mean prevalence of 37% ($\pm 5\%$ SEM) over the 15 week trial. Nevertheless, the prevalence of epicardial inflammation was greater in PRV 16-005ND challenged fish (mean 60 \pm 5% SEM) which was accompanied by a significant increase in the overall median endocarditis severity score relative to controls (Fig. 9A). The prevalence of epicarditis in 16-011D challenged fish was also nominally greater than in controls (mean $48 \pm 6\%$ SEM), but the change in median severity score was not significant.

Figure 9

Minor heart inflammation occurs during persistent late-stage PRV infections independent of donor fish disease status. (A) The cumulative prevalence of epicarditis, endocarditis and skeletal muscle lesions identify significantly increased prevalence of heart but not skeletal muscle lesions in PRV challenged fish within 15 wpc (*p < 0.05; **p < 0.01, ***p < 0.001). However, (B) the overall heart severity scores (combined mean inflammatory score for the atrium, epicardium, compactum and spongiosa) did not progress beyond a mean value of 1 (mild) in any treatment group at 3, 9, or 14 wpc. (C) Prevalence and severity of heart lesions assessed at 7 day increments throughout the trial (n = 6 per time point) also identified mild epicarditis and endocarditis which at some time points were significantly elevated relative to controls. The occasional occurrence of lesions of moderate severity was only observed in PRV infected groups.



Endocardial tissues provided a clearer association between PRV and heart inflammation, where both 16-005ND and 16-011D challenged fish had significantly greater median severity scores for lymphohistiocytic endocarditis compared to controls (Fig. 9A). This mainly occurred between 8 and 15 wpc in both challenge trials representing the post-peak persistent phase of PRV infection within these populations (Fig. 9C). PRV was not associated with skeletal muscle inflammation, and of the 10 (out of 270) fish with mild skeletal muscle inflammation (all cases were mild), 5 were from control, 2 were from 16-005ND and 3 were from 16-011D challenged populations.

Interestingly, fish challenged with PRV 16-005ND (which came from a nondiseased population) developed greater prevalence of heart inflammation than fish challenged with PRV 16-011D (sourced from fish with subclinical HSMI-like disease) (Fig. 9A). However, the overall severity of heart inflammation was generally mild in both PRV challenges (Fig. 9B), with typical heart tissues having no evidence of inflammatory lesions or only minor foci of inflammation (Fig. 10A-D). Indeed, the overall severity of heart lesions in PRV challenged fish (combined mean inflammatory score for the atrium, epicardium, compactum and spongiosa) was minor (mean score 0.9) even during the period of approximate highest prevalence and severity (9 wpc), which is below the severity threshold previously used to categorize an HSMI disease state (i.e., minimum total heart severity score > 1.5-2)[\$11]. One fish sampled during this study at 8 wpc (a PRV 16-005ND challenged fish) had both moderate epicarditis and endocarditis within the ventricle (Fig. 10E,F). However, even in this most extreme instance, the severity had not yet progressed into notable myocardial necrosis. The relatively minor impact of inflammation within heart tissues during this trial was further supported by a general lack of transcriptional induction for the inflammatory cytokine $IL-1\beta$ or the inflammatory chemokine IL-8 within PRV infected hearts (Fig. 11). Also, mild but significant antiviral responsiveness in heart tissues as demonstrated by Mx transcription was observed in response to both 16-005ND and 16-011D PRV challenge during the late-peak/early-persistent phase of infection; however, this which only partially overlapped the timing or severity of heart inflammation.

Figure 10

Complete range of histopathology in PRV 16-005ND and 16-011D infected fish encompassed no, low and moderate heart inflammation. Histopathology of hearts from PRV-injected and control fish at 8 week post-challenge identified (A,B) hearts with no microscopic lesions such as in control fish #184, (C,D) hearts with mild, focal, lymphohistiocytic epicarditis (arrowheads) such as in 16-011D challenged fish #191, or (E,F) hearts with either moderate lymphohistiocytic epicarditis (arrowheads), and/or endocarditis (arrows) such as from 16-005ND challenged fish #187. Note that fish #187 was the only fish in this study which had both moderate lymphohistiocytic epicarditis and endocarditis. Black boxes in the left column images outline the area shown at higher magnification in right column images; hematoxylin and eosin stain.

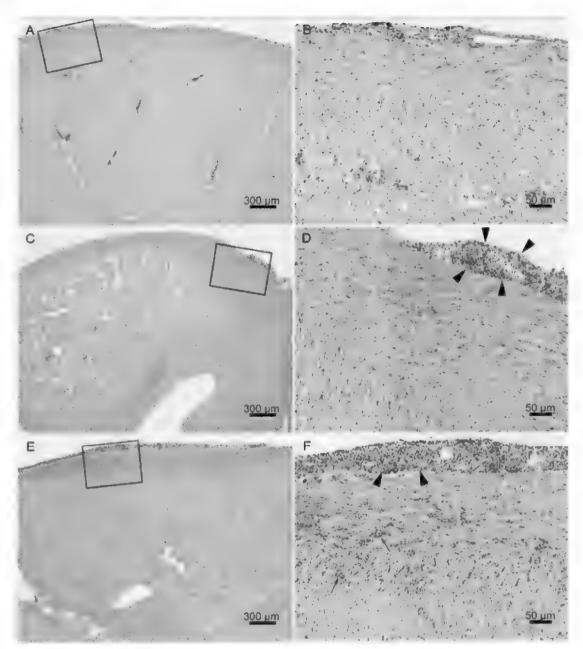
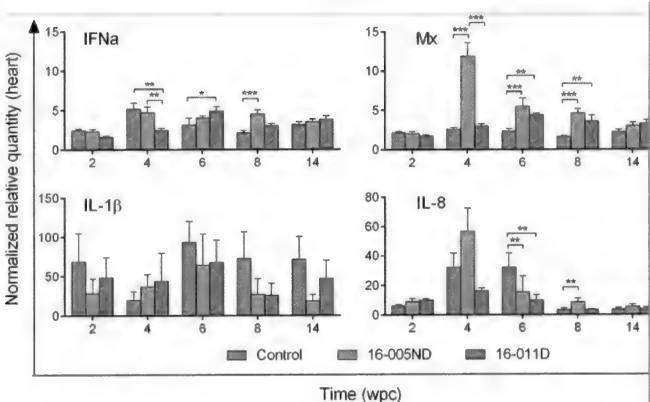


Figure 11

Minor and transient antiviral but not inflammatory gene transcriptional is induced in heart tissues following PRV infection. The transcriptional expression of IFNa and Mx, two classic viral response elements, had minor and transient up-regulation in response to PRV. Neither the inflammatory cytokine IL- 1β nor the inflammatory chemokine IL-8 had biologically relevant (> twofold) up-regulation within PRV infected heart tissues at the time points analyzed. Gene expression was normalized to the stable expression of β -actin and scaled to the minimum observed value.



Discussion

First identified in 2010, PRV represents the newest member assigned to the *Orthoreovirus* genus[18]. Although Orthoreoviruses are almost certainly the most well-studied within the *Reoviridae* family, there is considerable diversity in pathogenicity and disease association within the genus for which much is still unknown[36]. PRV adds yet further complexity by associating functional and genetic commonalities to both the Aquareoviruses and Orthoreoviruses while remaining phylogenetic and functionally distinct[1837, 64].

In Norway, most commercial Atlantic salmon become PRV positive, but only some develop HSMI. This does not appear to be dependent on systemic PRV load, and it is not clear why some farms experience high losses due to HSMI while others do not. Nevertheless, clinical outbreaks of HSMI in farmed Atlantic salmon of Norway are reasonably common[10, 11, 18, 38], and laboratory challenge trials have demonstrated a clear ability for PRV to cause severe heart lesions[1]. Indeed, laboratory challenges trials in Norway routinely generate severe heart lesions in accompaniment with occasional skeletal muscle lesions that are similar to lesions observed in diseased salmon on farms[11, 19, 20, 21, 39].

The results of our study expand our understanding of a strikingly divergent relationship regarding PRV and its association with disease in Pacific Canada. PRV also appears to be highly prevalent in farmed Atlantic salmon of Pacific Canada[5]; yet, only rare subclinical cases of farm-level HSMI-like pathology have been reported and a clinical outbreak of HSMI as described in Norway[10, 11] has never been described. Here we diagnosed one case of an HSMI-like disease state from a pre-transfer government farm site audit, with up to five additional cases being identified between 2011 and 2013[8, 7]. Even if all isolated cases of idiopathic cardiopathy observed during these audits were presumed to be HSMI, it would constitute approximate 2% prevalence within dead and dying farmed Atlantic salmon of British Columbia. Because annual mortality among farmed Atlantic salmon in Pacific Canada is about 10–15%, HSMI-like lesions would thus (at most) be associated with only about 0.3% annual mortality across the industry. In a laboratory setting, PRV from Pacific Canada has failed to cause severe heart lesions or any severity of skeletal muscle inflammation despite establishing high-load blood infections[13]. Here we confirm these findings using PRV from two different commercial sources in Pacific Canada which similarly replicated to high loads following experimental infection.

The consistent dissimilarity in disease outcome following PRV infection in Atlantic salmon of Norway versus Pacific Canada leads to the rather straightforward hypothesis that something within the host-pathogen-environment dynamic is different between these two geographic regions. One potential difference is that genetic divergence in PRV between these two regions is sufficient to result in altered virulence. The sequencing of PRV genomic material from two discrete sources in this study supports previous observations that PRV appears to have low phylogenetic diversity within farmed Atlantic salmon of Pacific Canada yet is relatively distinct from Norwegian isolates[14, 40] (Fig. 2B).

Small genomic changes can be enough to drastically alter the virulence of a virus, such as in the HPR0 variant within infectious salmon anemia virus (ISAV)[41] or VP2 variants of infectious pancreatic necrosis virus (IPNV)[42], and it is possible that one or more of the three putative amino acid changes unique to the PRV isolated from non-diseased fish used in this study could be held responsible for an increase in virulence. However, as pointed out previously[13], altered virulence associated with genetic viral variation are almost always accompanied by distinct tropisms and/or altered replication kinetics. For example, HPR0 variants of ISAV have altered tissue tropisms (gill specific rather than systemic)[43] and low-virulent IPNV variants are correlated with reduced *in vivo* loads compared to high virulence

stains[44]. Similar differential tropisms or replication kinetics do not appear to be evident when comparing PRV sourced from cohorts with (16-011D) and without (16-005ND) HSMI-like lesions in our study. Further, HSMI-like disease could not be passed from field-infected fish into a virtually identical cohort of Atlantic salmon held in a laboratory setting. We therefore hypothesize that at least in Pacific Canada, the ability for PRV to cause HSMI or any form of severe heart lesions cannot be attributed to a genetic variance variation of the virus alone.

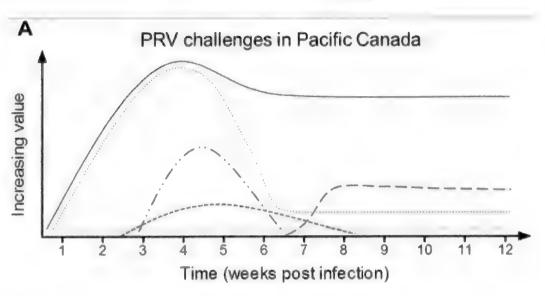
It is nevertheless possible that the previously reported instances of HSMI-like disease in Pacific Canada, although sharing similar microscopic lesions, were not generated by the same mechanism(s) as in Norway. For example, perhaps PRV was contributing to and exacerbating HSMI-like disease in farmed Atlantic salmon of Pacific Canada that was initiated by alternate or synergistic factors. By this reasoning, any of the 27 putative amino acid changes observed in this study between the Canadian and Norwegian strains of PRV variants could act alone or in concert to produce an altered state of virulence responsible for the rather striking prevalence discrepancy for HSMI in these two countries. It therefore becomes important to consider the phenotypic characteristics of PRV following analogous laboratory challenge trials conducted in Norway and Canada which may support this hypothesis.

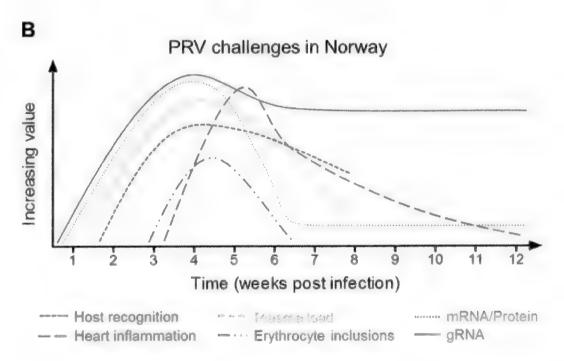
The phenotypic characteristics of both Canadian and Norwegian PRV during infection have at least three potentially significant dissimilarities (Fig. 12). First, the inability to detect Pacific Canada PRV (either 16-005ND or 16-011D) in the blood plasma of infected fish during our challenges is in stark contrast with PRV loads reported in plasma of infected fish following challenges with Norwegian PRV, where sometimes substantial PRV plasma loads are generated for a period lasting at least six weeks (2 to ≥ 8 weeks following detectable infections)[1, 39]. Second, there is a considerable difference in scale regarding host recognition of PRV. Although direct comparisons between Canadian and Norwegian studies are limited because Canadian studies have assessed gene expression relative to time-matched controls whereas Norwegian studies have referenced expression to time zero, it is nevertheless conspicuous that mean systemic and heart-specific antiviral responses increased no more than fivefold in our study whereas in Norwegian challenges these genes increased 10-50 fold in the blood[1, 45] and more than 100 fold in the heart[21]. The comparative lack of antiviral response to Pacific Canada PRV compared to Norwegian PRV is further supported by the relative protection PRV has afforded to fish challenged with a secondary virus (IHNV) in Norway[46] but not in Pacific Canada[28]. Lastly, in addition to the discrepancies concerning the

severity of heart inflammation, the timing of PRV associated heart inflammation is also different between challenges conducted with PRV from these two countries. Specifically, by either injection or cohabitation exposure of PRV, heart inflammation (prevalence and severity) in Norwegian studies consistently begins around the time of peak systemic PRV load, reaches high severity 1-2 weeks later, and thereafter diminishes[1, 20]. In contrast, increased prevalence of heart inflammation in our challenge trials did not occur until approximately 4 weeks after peak PRV systemic loads were reached and maintained high prevalence (although not severity) for the remaining 6-7 weeks of the trial.

Figure 12

Contrast summary for trends in PRV phenotypic infection dynamics between Norway and Canada laboratory challenge of Atlantic salmon. In comparing the present challenge trials conducted in (A) Pacific Canada with results from similar challenge trials conducted in (B) Norway[1, 21, 39, 45, 20], the kinetics of viral RNA, protein (indirectly measured in Canada by mRNA or directly measured in Norway by florescent antibody staining) and erythrocytic inclusion body formation follow a similar pattern. However, the kinetics regarding the plasma load of PRV, transcriptional induction of genes involved in innate host recognition of virus by Atlantic salmon, as well as the severity and timing of PRV associated heart inflammation appear notably discrete between the two countries. For these comparisons, timing is presented relative to first signs of infection at 10-12 °C and not necessarily the initiation of a challenge since detectable infections take longer to develop following cohabitation than by i.p. injection. It should also be noted that no data are yet available with regard to the transcriptional host innate immune responses or plasma PRV loads beyond 8 weeks post infection in Norwegian based studies and thus their late stage kinetics are unknown and not presented. Lastly, Y-axis scale is not intended to be interpreted as absolute.





Taken together, these findings suggest that phenotypic differences in infection kinetics between PRV from Norway and Pacific Canada stem at least in part from genetic variation between the two regional variants. Although a specific virulence factor (or set of factors) remains unclear, we hypothesize that the increased prevalence of Norwegian PRV outside red blood cells (i.e., in the plasma) might help to explain the heightened recognition of PRV by Norwegian fish and that this recognition could contribute to the elevated inflammatory immune responses observed. Because the S1 segment is responsible for the spread of mammalian orthoreovirus[47] and also has high genetic diversity between Norwegian and Canadian PRV[14], it presents a likely candidate for further investigation as a

virulence factor for PRV. However, the involvement of cytotoxic T-cells and a robust type-II interferon response generated in heart tissues of HSMI diseased Mowi Strain-Atlantic salmon in Norway[21] almost certainly enhances or even causes the observed tissue damage. PRV from Pacific Canada also elicits a specific cytotoxic T-cell response in heart tissues of Pacific-adapted Mowi-McConnell Atlantic salmon, but to far less of a degree[48]. This presents the possibility that HSMI might result (or be enhanced) by a host-associated hypersensitivity heightened in the Norwegian-adapted Mowi-strain of Atlantic salmon farmed in Norway relative to the Pacific-adapted Mowi-McConnell strain farmed in Pacific Canada. This hypothesis is supported by the development of an HSMI resistant strain of Mowi-Atlantic salmon in Norway that is somewhat resistant to disease but not PRV infection[49, 50]. Ultimately we believe that both host and virus specific factors likely play a role in the development of HSMI, and further investigations are needed to pinpoint the mechanisms responsible for generating this disease.

The kinetics of North American PRV in Atlantic salmon as observed in this study indicates three distinct phases of infection: early, peak, and persistencet infection. In the first (early) phase of infection which lasts 2-3 weeks at 10-12 °C, initial replication and dissemination of the virus into the blood cells of the host occurs. During this period, viral 'factories' (inclusions) were not observed in erythrocytes and there seemed to be no systemic recognition of virus by host cells. This indicates that the virus might be replicating by an alternative process relative to later time points or it might be initially infecting a different cell type. Mammalian orthoreoviruses first infect epithelial cells of the small intestine or lung prior to hematogenous dissemination[51]; and the recent detection of PRV in intestinal enterocytes[87] indicates that a similar course of infection might be followed by PRV. Regardless, it is expected that this early replicative phase dictates the overall severity of infection[52], as it likely accounts for how many erythrocytes ultimately become infected. This is supported by the discrepancy in total virus production following challenge with PRV 16-005ND compared to 16-011D in this study, where an initial lag in 16-011D replication appeared to be the major difference between otherwise identical replication dynamics within the two challenges. What caused the this poor primary infection rate following challenge with PRV 16-011D compared to 16-005ND is unclear; however, the lack of PRV transmission via fish cohabitation at this early stage of infection suggests that whatever cell type the virus is infecting during this period, it is not likely being shed into the environment to a high degree.

In the second (peak) phase of infection that lasts 2-3 weeks at 10-12 °C, substantial PRV replication within erythrocytes occurs along with the formation of cytoplasmic viral inclusions. The large spherical inclusions observed here wereare similar to those previously reported in Norway[39, 45, 53] as well as to those that develop during mammalian reovirus infection of well-established cell lines[54]. The highest systemic loads of PRV RNA that occur during this period; which appeared sufficient in some instances to initiate mild systemic host recognition of virus. As host recognition was only observed following 16-005ND challenge and not following PRV 16-011D challenge in this study, we speculate that this recognition might have been was load dependent since PRV 16-005ND reached higher transcriptional quantities during this period. From previous cohabitation challenges, it is also concluded that substantial shedding of virus occurs at this time[13].

In the third (persistent) phase of infection, viral inclusions within erythrocytes disappear. No systemic host recognition of virus occurs, and a marked reduction in viral protein production (as measured by mRNA concentration) occurs even though large quantities of genomic PRV material remain associated with the erythrocyte cell fraction. This supports the hypothesis that infectious PRV is retained in the cytoplasm of infected erythrocytes but is in a reduced or non-replicative state. The ability to recapitulate infectious replication of PRV from this late stage of infection was readily accomplished by injecting lysed blood cell material into naïve fish which generated comparable temporal infection dynamics to virus that had been harvested during the peak phase of infection (Fig. 6). However, poor viral transmission occurred via cohabitation during this late infectious stage, suggesting natural shedding of virus might be minimal during persistent infections and may even cease entirely over time. This is supported by the reduced rates of cohabitation infection by cohabitation at 15 wpc compared to 9 wpc in this study, and the inability to transmit virus via cohabitation after 45 toor 63 wpc as demonstrated previously[13]. Nevertheless, infectious virus was still present in the blood of infected fish in this study for at least 15 wpc and it is presumed that the rather substantial quantities of RNA detected in blood at 63 wpc by Garver et al.[13] also represented at least a moderate amount of infectious PRV particles.

For this study, we focused mainly on PRV L1 RNA to monitor viral loads in accordance with a number of previously published works[13, 18, 28, 55, 56, 57]. However, some studies have targeted alternate segments of the PRV genome for relative quantification. Specifically, Haatveit *et al.* identified differential temporal expression patterns—of PRV S1 compared to M2 and M3 during the persistent phase of infection in a Norwegian challenge trial, where the relative quantities of S1 were

approximately 9 Ct less than M2 and M3 (a >500 fold theoretical reduction)[45]. In our study, the relative quantity of all 10 genomic segments was comparable during all three phases of viral replication infection with less than fourfold proportional divergence between any two given segments (Fig. 5). This indicates that for the Pacific Canada PRV we tested, any of the 10 segments could be used interchangeably to estimate the PRV abundance within a sample at any given time. In Norwegain based studies, temporal expression patterns of L13[20] as well as M2 and M3[45] appear similar to what has been observed here; however, the considerable reduction in S1 expression observed by Haatveit *et al.*[45] provides yet further support for altered viral kinetics between Norwegian and Pacific Canadian strains of PRV that may stem from alterations in the S1 segment of the genome.

In addition to exploring the expression patterns of all 10 PRV genomic segments, we also developed a new and relatively simple technique for differentiating the amount of PRV single-stranded mRNA from double-stranded genomic material. It is likely that this technique can be applied in the detection of RNA from any virus with a dsRNA genome which might have expanded application in the laboratory exploration of dsRNA viruses. In specific context to PRV, we observed that the quantity of mRNA (and by implication the quantity of new viral proteins being made) became significantly reduced during the final persistent phase of infection. This is in line with previous observations of $\lambda 1$, $\mu 1$, $\sigma 1$ and $\sigma 3$ PRV protein production as noted in late stage infections of Atlantic salmon in Norway[45]. We also observed relatively minor but statistically significant proportional differences of mRNA quantities for individual PRV genomic segments which varied depending on the phase of infection. However, the implications for this latter variability is unknown and could be inconsequential given that almost all variation was encompassed within a twofold deviation from complete proportional equality.

One important aspect of the host immune response to PRV that was not addressed in this study was the putative development of antibodies. In Norway, host Atlantic salmon have been demonstrated to generate detectable antibodies specific to PRV μ 1c and μ NS in the plasma that began approximately two weeks after peak systemic PRV loads were reached and were maintained at detectable levels until the end of the study one month later[58]. It is unknown as to whether antibodies were generated against PRV in our current study; however, given the high viral loads, relative ease for horizontal transmission, and mild but significant innate antiviral recognition observed during peak PRV infections in this study, we speculate that at least some PRV specific antibodies were likely produced. If so, there may be future

potential in exploring the avirulent characteristics of the Pacific Canada PRV used here to potentially protect against Norwegian isolates of PRV that have been associated with causing HSMI, particularly since both formalin killed PRV and DNA plasimids expressing PRV μ NS have demonstrated at least partial protection against HSMI in Norway[22, 59].

In conclusion, although we were able to identify an HSMI-like disease state in farmed Atlantic salmon of Pacific Canada, this regionally rare condition could not be effectively transmitted via injection of PRV infected blood material into naïve fish as has been accomplished in Norway. This study also revealed genotypic and phenotypic differences between PRV from Pacific Canada compared to what has been reported from PRV challenge trials in Norway. These differences suggest that virus and/or host specific factors are likely needed for the development of HSMI in farmed Atlantic salmon and that currently PRV infections of Atlantic salmon in Pacific Canada are of low virulence. Further research is needed to determine the potential cause or causes for HSMI-like lesions in Pacific Canada. Also, because interactions between Atlantic salmon, PRV, and the environmental conditions of Pacific Canada do not appear conducive to HSMI development, the low virulence associated with Pacific Canada PRV provides a useful model for comparative studies to investigate the requirements for initiating PRV-associated disease and exploring possible protection mechanisms against PRV associated disease such as HSMI.

Methods

Fish source and husbandry

Atlantic salmon for the challenge studies were sourced from a single commercial freshwater hatchery on Vancouver Island, British Columbia and brought to the Pacific Biologic Station (PBS) in Nanaimo, British Columbia, Canada. Pretransport screening of 20 fish via qPCR was negative for PRV. Tissue homogenates from 90 fish in the hatchery were negative for culturable agents; no cytopathic effect was observed on CHSE or EPC cell lines prior to transport. Fish were of a Pacific-adapted Mowi-McConnell strain of Atlantic salmon with at least 30 years isolation from the originating European stocks[27]. Once at PBS, fish were maintained in UV treated municipal freshwater ($10^{\circ} \pm 1^{\circ}$ C) for 3 months prior to smoltification to undiluted sand-filtered UV-irradiated treated-seawater ($11^{\circ} \pm 1^{\circ}$ C, 32 ppt). A natural photoperiod was used during culture and fish were fed dry pellets (EWOS) at 1-2% body weight per day prior to challenge. This cohort was used as a source offor PRV negative control inoculum, provided the naïve recipients for the

primary PRV 16-005ND and 16-011D i.p. injection challenges, and also provided the naïve recipients for the subsequent i.p. and cohabitation viral passage experiments using PRV 16-005ND. During all challenge trials, fish were maintained on undiluted UV-irradiated treated seawater ($11^{\circ} \pm 1^{\circ}$ C, 32 ppt) and fed a ration of EWOS pellets at 1% body weight per day.

PRV detection and quantification

PRV (L1) detection by TaqMan qPCR

PRV nucleic acid was detected from blood, heart and plasma samples by real-time qPCR with slight modification to previously described methods[13, 28]. In summary, total RNA was extracted from 100 μL blood, 100 μL plasma, or ~50 mg heart tissue in TRIzol Reagent (Life Technologies) as per manufacturer's instructions using 5 mm steel beads and TissueLyser II (Qiagen) which operated for 2 min at 25 Hz. A portion of eluted RNA (1.0 µg) was denatured for 5 min at 95 °C, immediately cooled to 4 °C, and reverse-transcribed using a High Capacity cDNA Reverse Transcription kit (Life Technologies) following the manufacturer's instructions. Resulting cDNA was used directly as template for qPCR analysis in a StepOne-Plus real-time detection system (Applied Biosystems) using primers and TagMan probe targeting the L1 fragment of the PRV genome[28]. Each reaction contained 400 nM primers and 300 nM TaqMan probe, 1X TaqMan Universal Master Mix and 1 µL cDNA template within each 15 µL reaction. Cycling conditions included an initial incubation of 95 °C for 10 min followed by 40 cycles of 95 °C for 10 s and 60 °C for 20 s. Samples were assayed in duplicate and were considered positive if both technical replicates reported a Ct value < 40 cycles. Absolute PRV quantification was determined in each instance by serial dilution of a 482 bp double-stranded DNA gBLOCK fragment (Integrated DNA Technologies) consisting of sequence targeted by the qPCR primer and probe[13]. A seven-step 10-fold dilution series of the gBLOCK fragment spanning a dynamic range of 10-10⁷ target copies per reaction was incorporated in duplicate into each run. The limit for accurate quantitative assessment (< 20% CV) using this technique was calculated to be between 10-50 copies with a limit of detection (at >90% prevelence between replicates) of 1–3 copies per reaction determined as previously described[5765].

PRV (all segment) detection by SYBR® green qPCR

Primers specific to each of the 10 PRV genome segments were designed using Primer3[5866] within the Geneious 9.1.7 software platform[5967] to homogenous protein-coding regions within four published PRV genomes previously identified

from Pacific Canada: VT06062012-358[40]; BCJ19943_13[14]; and WSKFH12_14[14] (Supplement 1). A portion (1 μL) of cDNA generated using a High Capacity Reverse Transcription kit from Trizol extracted RNA as described above was added to duplicate 15 μL qPCR reactions containing 500 nM forward and reverse primers and 1x final concentration of Power SYBR® green PCR master mix (ThermoFisher) in molecular grade water. Reactions were analyzed in a StepOne-Plus real-time qPCR detection system (Applied Biosystems) with an initial polymerase activation at 95 °C for 10 min followed by 40 cycles 5 s at 95 °C, 20 s at 60 °C, and 10 s at 72 °C with fluorescence measured at the end of the 72 °C step. Melt curve analyses were performed to ensure amplification specificity and a five-step fourfold dilution series of cDNA prepared from the blood of a highly infected individual (sample #35; 16-005ND4 at 4 wpc) was performed in duplicate on each run to estimate relative quantity and amplification efficiency.

ssRNA PRV qPCR detection and validation

All TaqMan or SYBR qPCR analyses designed to exclusively amplify the ssRNA and not dsRNA component of the targeted PRV segment were performed as described above with the exception that RNA was heated to 80 °C for 1 min rather than 95 °C for 5 min prior to cDNA synthesis. Total RNA from PRV 16-005ND infected fish at 10 wpc was used to validate this differential detection of PRV ssRNA by exposing totalextracted RNA (2 µg) to either no enzyme, 2 U Pure LinkTM RNAse A (ThermoFisher Scientific), or 2 U RNAse A in the presence of 0.5 M sodium chloride which selectively protects dsRNA but not ssRNA from RNAse A degradation[60]. Following incubation at 25 °C for 45 min, RNA (if remaining) was recovered using RNeasy MinElute Cleanup Kit (Qiagen) as per manufacturer's instructions. Recovered RNA was heated to either 55 °C for 5 min, 80 °C for 1 min, or 95 °C for 5 min, immediately cooled to 4 °C and reverse transcribed using a High Capacity cDNA Reverse Transcription kit (Life Technologies) following the manufacturer's guidlines. Resulting cDNA was used directly as template for PCR analysis in a StepOne-Plus detection system with 500 nM PRV L1 (this study) or Atlantic salmon β-actin[13] forward and reverse primers and 1X Power SYBR® Green PCR master mix (ThermoFisher). Cycling conditions were performed as described above but were ended after 30-cycles prior to fluorescence saturation in samples for which product was amplified. A portion (5 uL) of product was then visualized by UV excitation on a 3% agarose Tris-borate-EDTA (TBE) gel containing 0.5x SYBR® Safe DNA stain after 45 min migration at 120 volts in 1X TBE running buffer (ThermoFisher).

PRV sequencing

Library construction, sequencing services and bio-informatics support was provided by the Canadian Centre for Computational Genomics and Génome Québec Innovation Centre, Montréal, Canada. RNA extracted from the blood of four fish were selected for library construction and RNA-seq analysis – two from fish challenged with PRV 16-005ND (sample numbers 161 and 165; see Supplement 1) and two from fish challenged with PRV 16-011D (sample numbers 167 and 171) collected at 7 wpc (Fig. 2A). A portion (10 µg) of the total RNA extracted from each samples was purified using 2 U of DNase I (Life technologies) at 37 °C for 45 min followed by RNeasy MinElute Cleanup (Qiagen) as per manufacturer's instructions. RNA quality was visualized on a 1% bleach denaturing gel[6+68] and ensured to have a Bioanalyzer (Agilent) RNA Integrity Number (RIN) > 9. RNA sequencing was performed using half of one lane (8 libraries per lane) of an Illumina® HiSeq 2500 (Illumina Inc.) platform using a NEBNext® rRNA Depletion Kit (Human/Mous/Rat) with read lengths of 125 bp. Base calls were made using the Illumina CASAVA pipeline encoded in Phred 33. The two libraries generated for both 16-005ND and 16-011D challenges were pooled and de novo transcript assembly was performed on combined reads (2 libraries per assembly) following the pipeline described by Haas et al. [6269] based on the Trinity assembly software suite[6329]. In brief, reads were trimmed using Trimmomatic software[61] from the 3' end with a minimal Phred score of 30 and a minimum length of 32 bp. A normalized metric of reads was generated using Trinity normalization utility and surviving paired reads were assembled using the Trinity assembler[6269]. Putative assembled transcripts were aligned against the NCBI Viral Genomes Resource database[62] using the blastn program from the NCBI BLAST family. Transcripts which aligned to PRV sequences with an Expect value (E value) less than e-100 were aligned by segment using Geneious 9.1.7 to report the consensus sequence for the longest positive-sense genomic strand in each instance.

PRV and HSMI sampling during natural infection

Moribund or recently deceased net-pen farmed Atlantic salmon were collected as part of a pretransfer fish health audit conducted by the Fisheries and Oceans Canada, Aquaculture Management Division. With relevance to this study, skeletal muscle and heart tissues were preserved in 10% neutral buffered formalin and processed as previously described[5]. On July 5th, 2016, an audit of 40 fish (36 moribund/dead; 4 live) was conducted at a net-pen farm site in the Johnstone Strait of BC, for which skeletal muscle and heart tissues were collected for histology. The site had 12 operational pens; each containing between 30–50 thousand fish per pen

with fish weighing approximately 500 g each. On July 29th and August 7th, 2016, samples of heart and skeletal muscle from 5 and 6 moribund/dead fish, respectively, were also collected for histology by a private veterinarian working for the source farm.

A final sampling was conducted August 19th, 2016 by MPP and KAG, in which 20 fish were sampled specifically for this study – six fish were moribund/fresh dead, eight were from the general population (apparently healthy), and six were non-performers of low body condition. Blood (0.5–3 mL) was collected from the caudle vein of each fish using 22 gauge needle and 3 mL syringe. A 100 μL subsample was immediately frozen in liquid nitrogen and used for PRV L1 TaqMan qPCR screening as described above. Remaining blood was divided into 1 mL aliquots and stored at –80 °C for use in generating challenge inoculating material described below. Heart and skeletal muscle from each fish was preserved in 10% neutral buffered formalin for histopathologic evaluation.

PRV challenge of Atlantic salmon by i.p. injection

Inoculum preparation

PRV 16-005ND was initially sourced from a cohort of healthy Atlantic salmon in March of 2016 held at a commercial freshwater Atlantic salmon rearing facility on Vancouver Island, Canada. The facility had no history of HSMI and PRV material collected from this site in 2013 had failed to generate HSMI in previous laboratory challenge trials[13, 28]. PRV infected blood of hatchery fish (~25 g) which had been frozen at -80 °C prior to use was passed through ~30 g British Columbia Mowi-McConnell Atlantic salmon held in brackish water (15ppt) for three weeks at 11 °C, passed again through ~50 g Atlantic salmon held in seawater (32 ppt) for three weeks at 11 °C, and passed a third time in ~55 g Atlantic salmon held in seawater for four weeks at 11 °C prior to final collection. In each instance, blood from three infected fish was pooled, diluted 1:10 in Hank's balanced salt solution (HBSS), sonicated on ice for 80 s in 10 s bursts with 30 s rests using a Branson Digital Sonifier 250/450 at 20% amplitude, clarified via centrifugation at 2,000 × g for 5 min at 4 °C, and administered to naïve fish by 100 μL intra-peritoneal injection. Following the third passage, blood from three fish was pooled and inoculate prepared as for previous passages.

PRV 16-011D was sourced from the blood of three fish (#3, 5, 15) collected at the net-pen farm site in which fish had HSMI-like lesions on August 19th, 2016 (Supplement 1). The blood from these fish was pooled, diluted 1:10 in HBSS,

sonified and clarified as described for 16-005ND. An identical preparation of sonified and clarified diluted blood was prepared from a pooled sample of three PRV-free individuals sourced from the cohort of fish used for all subsequent challenge trials to provide vehicular control inoculate.

Intra-peritoneal injection and monitoring

Atlantic salmon (~70 g each) were anesthetized in an aqueous solution of Tricaine methanesulfonate (0.05 g/L) and given a 200 μ l intra-peritoneal injection of either PRV 16-005ND inoculum, PRV 16-011D inoculum, or PRV-free vehicular control inoculum (90 fish per treatment). Fish were placed in treatment-specific 850 L circular tanks (one tank per inoculum) supplied with 30 L/min 11 °C (\pm 1 °C) UV-irradiated treated-seawater (32 ppt). Temperature, dissolved oxygen, feeding performance, and morbidity/mortality were monitored daily throughout the challenge trials (Supplement 1).

PRV and HSMI associated sampling

Fish were anesthetized in an aqueous solution of Tricaine methanesulfonate (0.05 g/L), and blood and tissue samples were collected from six fish per treatment tank at 7 day intervals through 15 wpc. Blood (~2 mL) was collected using a 22 ga needle and 3 mL syringe. A 100 µL aliquot was immediately frozen in liquid nitrogen and subsequently used for PRV screening and gene expression analysis by qPCR as described above. Approximately 10 μL was transferred to a sodiumheparin treated FisherbrandTM micro-hematocrit tube and spun at 15,000 × g for 10 min for hematocrit determination. and a second 10 µL was smeared on a glass microscope for cytoplasmic inclusion body visualization. Slides were air dried. fixed in 100% methanol for 5 min, and stained with pinacyanol chloride[39]. Remaining blood was transferred to a heparinized vacutainer and spun at $2,000 \times g$ for 5 min at 4 °C. Plasma (100 µL) was transferred to a clean 2 mL microtube and immediately frozen at -80 °C prior to PRV qPCR screening as described above. An approximate 200 mg section of red/white skeletal muscle was excised from the left lateral line at approximately the mid-body and preserved in 10% neutral buffered formalin for histopathology. Hearts were bisected longitudinally and one half preserved in 10% neutral buffered formalin for histopathology while the other half was immediately frozen in liquid nitrogen for qPCR analyses. Tissues in 10% NBF were fixed for 24-48 hours, transferred to 70% isopropanol and paraffin embedded following standard methods. Sections 3 µm thick were transferred to glass slides and stained routinely with haematoxylin and eosin for light microscopy[5]. Photomicrographs were optimized for illumination and color balance [63]. To ensure

inter-sample consistency in lesion scoring as well as consistency relative to published PRV studies from Norway, approximately 10% of slides (29/338) were examined by both principal pathologists (GDM and HNS) and a subset of 60 slides was also sent to a third reviewing pathologist (RJ) in Norway for further examination (Supplement 1). All histopathology was conducted blind to PRV exposure status and scores provided by the other pathologists.

At 10 wpc PRV 16-005ND, blood of three fish was separated into plasma, leukocyte, and erythrocyte components. Plasma was collected following centrifugation of the heparinized blood at 2,000 × g for 5 min at 4 °C. The cell pellet was suspended to an original blood volume using HBSS and layered over a 34%/51% isotonic percoll discontinuous gradient and centrifuged at 800 × g for 20 min at 4 °C which was allowed to come to rest without the use of the centrifuge breaking system. Peripheral blood leukocytes were harvested from the 34%/51% interphase and erythrocytes from the pelleted material below the 51% layer. Cells were washed twice with HBSS, verified for >99% purity via hemocytometer, and suspended at a final concentration of 10e⁷[7] cells per 100 μL HBSS which was used for PRV qPCR screening.

Passage of PRV via cohabitation or i.p. injection

PRV 16-005ND inoculate not used in the injection challenge above was thawed and administered to three sets of 15 fish (\sim 150 g per fish) by intra-peritoneal injection, 200 µL per injection, under MS-222 anesthesia. Fish were cultured in 850 L tanks as above with the exception that the volume of 11 °C seawater was reduced to 250 L and supplied with a flow of 15 L per min. After a period of 1, 9, or 15 wpc, an equal number (n = 15) naïve cohabitants (with clipped adipose fins) were introduced to each to the three tanks. Blood samples were collected from six of both injected (shedder) and introduced (sentinel) fish after 4 and 8 weeks of cohabitation and screened for PRV L1 transcripts as described above.

Comparative analyses

Trinity assembled PRV segments were concatenated and compared to two previously published PRV genomes (B5690 and V3621) by Jukes-Cantor phylogenetic relationship analysis using Geneious software. The relative quantities (scaled to the minimum value) of PRV L1 transcripts following differential preamplification denaturation were compared at 2, 4, and 10 wpc for both PRV 16-005ND and 16-011D challenged groups by one-way ANOVA and Tukey post-test of log-transformed data. The proportional change of PRV ssRNA (relative to total

PRV RNA) was as assessed over time in both PRV 16-005ND and 16-011D challenged groups by one-way ANOVA and Dunnett's multiple comparison posttest of arcsin-transformed values. The relative quantity (scaled to the minimum value) of each PRV 16-005ND RNA segment as well as the single-stranded mRNA proportion of each segment was assessed at 2, 4, and 10 wpc by two-way ANOVA with Bonferroni post-tests following log-(relative quantity) and arcsin-(proportional quantity) transformation. The contributing proportion toof total PRV RNA and total single-stranded mRNA ofby each segment were considered independent and dependent to time, respectively, by two-way ANOVA. Thus, total PRV segment expression was pooled from 2, 4, and 10 wpc and compared by one-way ANOVA and Tukey's post-hoc test of arcsin transformed values and single-stranded mRNA proportional expression was compared separately at each time point by one-way ANOVA with Dunnett's multiple comparison post-test relative to L1. The trend in hematocrit of both PRV 16-005ND and 16-011D challenged fish were compared to controls by two-way ANOVA with Bonferroni post-tests of arcsine transformed values. This was similarly applied to comparing the quantity of erythrocyte cytoplasmic inclusion bodies observed in PRV 16-005ND versus 16-011D infected fish. All gene expression data was normalized to β-actin transcription. Normalized quantities were scaled to the minimum value for each gene prior to analysis of logtransformed data by two-way ANOVA with Bonferroni post-tests. Heart and skeletal muscle histopathology inflammation scores for PRV 16-005ND and 16-011D infected fish estimated at each time point throughout challenge was compared to control fish by Mann Whitney U tests without multiple comparison adjustment.

Ethics statement

All work with animals was performed in strict accordance with the recommendations set out by the Canadian Council on Animal Care (CCAC) guide to the care and use of experimental animals and all live animal protocols were approved by the Pacific region animal care committee (animal use protocol number: 16–013). All fish handling was performed under Aquacalm[™] (Syndel Laboratories Ltd.) or tricaine methanesulfonate (MS222) anesthesia.

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Supplementary information

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Author Contributions

M.P.P. and K.A.G. conceived and designed the study. M.P.P. conducted sampling, performed data analysis and interpretation, and drafted the manuscript. G.D.M. and H.N.S. performed histopathological examination. All authors read, contributed to, and approved the final manuscript.

Data Availability

Data presented in this manuscript are provided in sSupplement 1, available through NCBI SRA SRP145317, or NCBI GenBank accessions MH347359 – MH347378.

Competing Interests The authors declare no competing interests.

Supplementary information

Dataset 1

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High-Load Reovirus Infections Do Not Imply Physiological Impairment in Salmon

Yangfan Zhang^{1†}, Mark P. Polinski^{2†*}, Phillip R. Morrison³, Colin J. Brauner³, Anthony P. Farrell^{1,3} and Kyle A. Garver^{2*}

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The recent ubiquitous detection of PRV among salmonids has sparked international concern about the cardiorespiratory performance of infected wild and farmed salmon. Piscine orthoreovirus (PRV) has been shown to create substantial viremia in salmon by targeting erythrocytes for principle replication. In some instances, infections develop into heart and skeletal muscle inflammation (HSMI) or other pathological conditions affecting the respiratory system. Critical to assessing the seriousness of PRV infections are controlled infection studies that measure physiological impairment to critical life support systems. Respiratory performance is such a system and here multiple indices were measured to test the hypothesis that a low-virulence strain of PRV from Pacific Canada compromises the cardiorespiratory capabilities of Atlantic salmon. Contrary to this hypothesis, the oxygen affinity and carrying capacity of erythrocytes was unaffected by PRV despite the presence of severe viremia, minor heart pathology and transient cellular activation of antiviral response pathways. Similarly, PRV-infected fish had neither sustained nor appreciable differences in respiratory capabilities compared with control fish. The lack of functional harm to salmon infected with PRV in this instance highlights that, in an era of unprecedented virus discovery, detection of viral infection does not necessarily imply bodily harm and that viral load is not always a suitable predictor of disease within a host organism.

Keywords: piscine orthoreovirus, salmon, aerobic performance, heart inflammation, viremia, nucleated erythrocytes

INTRODUCTION

Animal viruses are expected to inflict harm to the host cells they infect, either as a direct result of infection or as a product of host-directed apoptosis (Kaminskyy and Zhivotovsky, 2010). As a consequence, all animal viruses can be defined as putatively pathogenic, varying only in their potential virulence (i.e., their relative ability to cause damage) (Pirofski and Casadevall, 2012). In cases where highly virulent viruses are linked to serious disease, the presentation of severe clinical symptoms such as morbidity or death clearly represent states of reduced fitness and are usually conditional on the quantity of virus produced during infection (Griffiths, 1999). However, harm inflicted to animals experiencing infections of either low intensity or low virulence becomes far

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Importance:

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Hello Everyone,

Many thanks, Danielle

----Original Appointment-----

From: Krahn, Danielle

Sent: Wednesday, March 6, 2019 3:24 PM

To: Krahn, Danielle; House, Matthew (DOJ); Moore, Wayne; Parsons, Jay; Thomson, Andrew; Webb,

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Lesley; Payne, Brigid; Quinn, Caroline

Cc: Ikejiani, Alexander (DOJ); Levesque, Marie-Pier (DOJ); Lowe, Carmel; Salomi, Corino; Martell, D

John; Burgetz, Ingrid; Pilcher, Scott; Nielsen, Ingrid

Subject:

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From: MacDougall, Lesley
Sent: March-07-19 1:06 PM

To: Webb, Allison Cc: Lowe, Carmel

Subject: RE: PRV papers communication summary

Attachments: RE: upcoming publications - media attention for them?

Hi Allison – it was some of the work identified in the "PRV summary document" from a few months ago, and we prepared a Tab 9 summary though I'm starting to think it somehow did not get submitted properly, as it seems to be taking folks by surprise – I'm trying to follow up to determine where we went off the rails. It was also considered during the development of the PRV risk assessment last month.

Lesley

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: March-07-19 12:59 PM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley.MacDougall@dfo-

mpo.gc.ca>

Subject: FW: PRV papers communication summary

Hi you two – I'm not aware of this – first I'm seeing of it. Hoping that you're more up to speed and really appreciate an abstract if you have it. I know that everyone is incredibly busy so it was likely overlooked in the deluge of work.

Thanks so much, Allison

Allison Webb, Director / Directrice
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From: Rainer, Michelle < Michelle.Rainer@dfo-mpo.gc.ca >

Sent: Thursday, March 7, 2019 12:53 PM

To: Webb, Allison <<u>Allison.Webb@dfo-mpo.gc.ca</u>> **Subject:** FW: PRV papers communication summary

Hi Allison, FYI

Issue: Two DFO Science papers on piscine orthoreovirus (PRV) will be published on March 13. The papers are separate but related and will appear in the journals *Frontiers of Physiology* and *Scientific Reports*. DFO funded and co-authored both studies; however, the *Frontiers of Physiology* paper was done in conjunction with UBC and researchers the province of BC's Animal Health Centre contributed to the *Scientific Reports* study. UBC is issuing a press release (attached).

These two papers informed the work of a recent Canadian Science Advisory Secretariat (CSAS) peer review on the risk of PRV to wild salmon in the Discovery Islands. Subsequently, several members of the media asked DFO if they could see the papers, which the department could not release as they were under embargo by the journals prior to publication.

The studies investigated PRV infection dynamics and its potential to cause disease in salmon. The *Scientific Reports* study demonstrated that the PRV currently present in British Columbia has a limited capacity for causing disease in Atlantic Salmon (less so than the PRV in Norway) and that the HSMI-like disease previously reported in British Columbia could not be linked exclusively to PRV infection or transmitted to healthy fish. The *Frontiers of Physiology* paper demonstrated no functional harm to Atlantic salmon is inflicted by high-intensity PRV infections that were equal to, if not higher, than those seen naturally in wild or farmed fish, thereby reducing the uncertainty that PRV may be compromising salmon performance in the absence of acute disease.

Proactive Communications: Once they are published, Pacific Region Communications plans to tweet a link to the articles and contact environmental reporters who have been following this story with an offer to interview DFO's Kyle Garver or Mark Polinski, two of the authors of the papers, on these findings. Earlier action is not possible as the papers are under embargo prior to publication.

Tweet:

New DFO research fills in critical knowledge gaps concerning piscine orthoreovirus (PRV) and salmon health.

From: Webb, Allison

Sent: March-07-19 2:58 PM

To: MacDougall, Lesley; Lowe, Carmel; Kennedy, Eddy; Holmes, John; Salomi, Corino

Cc: Patirana, Anoma; Waddington, Zac; Paylor, Adrienne

Subject: RE: Teleconference: PRV task team - workplan for responding to 'Namgis decision'

Attachments: Information That Could Be Collected To Inform Decision Maker regarding Wild Fish.docx

This is a very rough start and needs a ton more work with all of your help ... Particularly need to clarify the purpose of info being collected and/or analyzed.

I just realise that I didn't include anything on FVcom or particle tracking. Not sure if that is also germane.

I hope that it is of some use and look forward to discussing further, Allison

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

----Original Appointment----From: MacDougall, Lesley

Sent: Thursday, March 7, 2019 10:31 AM

To: MacDougall, Lesley; Lowe, Carmel; Kennedy, Eddy; Holmes, John; Salomi, Corino; Webb, Allison

Subject: Teleconference: PRV task team - workplan for responding to 'Namgis decision When: Monday, March 11, 2019 12:00 PM-1:00 PM (UTC-08:00) Pacific Time (US & Canada).

Where: Teleconference

Hi all – acknowledging that everyone is completely booked...if lunch time tomorrow doesn't work (sorry!) I'll look for something Monday

Before the national train barrels out of the station, a regional check in is advised. My sense from today's call is that a lot of the management side of these q's has already been collated, and within science we will also have summary info for aggregates – we will want to start pulling this information together, so this call is to help us shape how to best articulate what we already have and identify what's still needed (and possible) given the short response time.

To inform the direction on 'harm':

What is the appropriate aggregate unit? – what is the limit of our current information on wild salmon – populations, MU's, CU's, other?

What do we know at that aggregate unit? What is the status (where we have it), what do we use to describe relative success/strength if we don't have status assessments?

How does that aggregate unit intersect with aquaculture and hatchery influences

At what spatial and temporal scale?

What do we currently do to assess 'harm' already in SEP and AMD?

What measures are relevant and currently in place to mitigate 'harm'?

What guidance can sci provide regarding eval of 'harm' with what we already know about risk factors?

Information That Could Be Collected To Inform Decision Maker regarding Wild Fish/Aquaculture/SEP fish interactions and fish health status and risk to wild salmon as well as aggregates

Current Information Available

Information Type or Nature of Into	Lead to	Other comments	Purpose
	collect /		
PRV Risk Assessment	Jay Parsons	Require a summary of information that can be provided as science advice to the decision maker	
		Can this information be generalized to be used in	
		other areas in BC? Broughton?	
Farmed fish list of disease agents tested	Allison Webb	Can immediately provide	
SEP fish list of disease agents tested	Corino	Can immediately provide	
	Salomi		
Trends of aqua fish mortalities including disease	AMD	Requires some analysis, but generally readily	
prevalence over time		available through our time series of 10+ years. Need	
		to decide on scope and may focus on Broughton	
		Area first. Need to define that in a common way in	
		terms of geographic boundaries. Can also provide	
		info on chinook.	
Trends in SEP fish mortalities including disease	Corino	Not sure if this is readily available or requires	
prevalence over time	Salomi	significant analysis	
Information on status of wild stocks particularly	ADM	AMD provided info on GPS coordinates of farms to	
those that are red and yellow listed and their	Science Pac	Science for their consideration	
lifecycle histories, migration routes and overlay		Science to conduct work that is time consuming and	
vis-à-vis salmon farms		may need to scope to Broughton area to start. Would	
		recommend looking at all species, but if pressed for	
		time, chinook could be of a higher priority?	
Information from Kintama and Chrys Neville's	Science Pac	Pre-publication? Not sure in what form this is	
work on timing of salmon migration and time spent by farms		currently, what species are covered?	

Information from Science on Environmental changes that could cause mortality like HAB	Science Pac	
Information from SSHI that provides info on disease profiles in SEP/farmed/wild fish	Science Pac	Pre-publication and would need to be summarized or data provided
Information on impacts of SEP on wild fish	Science Pac	Not sure if there has been any work done on impacts of hatcheries
Information on stock assessment data quality at the CU/MU/stock level relative to salmon farms to provide advice on the appropriate aggregate	Science Pac	

Future Information that could be included

Information Type of Nature of Info	Lead to collect or propose	Other comments	Purpose
	research to generate		
RA on other species re PRV?			

Other Relevant Information / Framework Documents etc:

FARM

- POE and Operational Decision Making Framework for Finfish
 - Risk Assessments PRV others?
- Review documents used by decision maker currently re s. 56 licences

No information has been removed or severed from this page

From:

Kennedy, Eddy

Sent:

March-07-19 10:56 PM

To:

MacDougall, Lesley; Lowe, Carmel; Holmes, John

Subject:

Re: For Urgent Review: PRV Policy Task Team Meeting

My rudimentary thoughts for 11pm at night.

Sent from my Bell Samsung device over Canada's largest network.

s.21(1)(a)

s.21(1)(b)

----- Original message -----

From: "MacDougall, Lesley" < Lesley. MacDougall@dfo-mpo.gc.ca>

Date: 2019-03-07 3:11 PM (GMT-08:00)

To: "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca>, "Kennedy, Eddy" < Eddy.Kennedy@dfo-mpo.gc.ca>,

"Holmes, John" < John. Holmes@dfo-mpo.gc.ca>

Subject: RE: For Urgent Review: PRV Policy Task Team Meeting

Hi Carmel, Eddy, John:

For quick context for Eddy and John – a PRV Policy Task Team is meeting regularly (now 2x a week) to pull together the response to the 'Namgis decision. it has largely been led out of NHQ, and only recently were pacific region science included. Based on the depth of development I don't think we missed much. We are being asked for our input on the proposed workplan – my main comment at this point (likely irrelevant)

why there is a meeting request to you for tomorrow, or Monday if we need to move it: what can we reasonably put together

I think you're both at meetings so I'm not expecting a lot of feedback but wanted to give you as much notice as possible that this is in play.

Carmel – from my perspective, the workplan is unnerving but I don't sense we have much latitude about what we need to get done.

Lesley

From: Krahn, Danielle < Danielle. Krahn@dfo-mpo.gc.ca>

Sent: March-07-19 12:48 PM

To: House, Matthew (DOJ) <Matthew.House@justice.gc.ca>; Moore, Wayne <Wayne.Moore@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Patirana, Anoma <Anoma.Patirana@dfo-mpo.gc.ca>; Haesevoets, Roderick <Roderick.Haesevoets@dfo-mpo.gc.ca>; Campbell, John P. <John.Campbell@dfo-mpo.gc.ca>; Khatkar, Sunita <Sunita.Khatkar@DFO-MPO.GC.CA>; MacDougall,

Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Payne, Brigid <Brigid.Payne@dfo-mpo.gc.ca>; Quinn, Caroline <Caroline.Quinn@dfo-mpo.gc.ca>

Cc: Ikejiani, Alexander (DOJ) <Alexander.Ikejiani@justice.gc.ca>; Levesque, Marie-Pier (DOJ) <marie-pier.levesque@justice.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>; Salomi, Corino <Corino.Salomi@dfo-mpo.gc.ca>; Martell, D John <John.Martell@dfo-mpo.gc.ca>; Burgetz, Ingrid <Ingrid.Burgetz@dfo-mpo.gc.ca>; Pilcher, Scott <Scott.Pilcher@dfo-mpo.gc.ca>; Nielsen, Ingrid <Ingrid.Nielsen@dfo-mpo.gc.ca>

Subject: RE: For Urgent Review: PRV Policy Task Team Meeting

Importance: High

Hello Everyone,

Per today's meeting, grateful if you could review the attached revised work plan and provide comments to me by **COB today**.

Many thanks, Danielle

-----Original Appointment-----

From: Krahn, Danielle

Sent: Wednesday, March 6, 2019 3:24 PM

To: Krahn, Danielle; House, Matthew (DOJ); Moore, Wayne; Parsons, Jay; Thomson, Andrew; Webb, Allison; Patirana, Anoma; Haesevoets, Roderick; Campbell, John P.; Khatkar, Sunita; MacDougall, Lesley; Payne, Brigid; Quinn, Caroline

Cc: Ikejiani, Alexander (DOJ); Levesque, Marie-Pier (DOJ); Lowe, Carmel; Salomi, Corino; Martell, D John; Burgetz, Ingrid; Pilcher, Scott; Nielsen, Ingrid

Subject: PRV Policy Task Team Meeting

When: Thursday, March 7, 2019 10:30 AM-11:30 AM (UTC-05:00) Eastern Time (US & Canada).

Where: 10N196 + Teleconference

Please note change in location for today's meeting.

DIAL IN #: 1-877-413-4791 / 613-960-7515

Conference ID:

From:

Moore, Wayne

Sent:

March-08-19 9:16 AM

To:

Lowe, Carmel

Subject:

RE: PRV papers communication summary

Thanks for this btw. Not sure where these discussions are happening on the comms strategy but we should be careful about the tweeting thing just in the context of the question of whether the department is profiling only the science that supports its positions and not all the science we do and then of course there is an LR perspective.

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: March 7, 2019 4:04 PM

To: Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-

mpo.gc.ca>

Cc: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Moore, Wayne <Wayne.Moore@dfo-

mpo.gc.ca>

Subject: RE: PRV papers communication summary

Not sure why these pubs are causing the flurry of concern at this time. We had flagged them to NHQ more than a month ago. Results from both studies were fully considered in the recent CSAS risk assessment

In any case attaching both manuscripts here along with the UBC press release.

We will be submitting a ROCS entry on this.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: March 7, 2019 12:59 PM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca >; MacDougall, Lesley < Lesley.MacDougall@dfo-

mpo.ac.ca>

Subject: FW: PRV papers communication summary

Hi you two – I'm not aware of this – first I'm seeing of it. Hoping that you're more up to speed and really appreciate an abstract if you have it. I know that everyone is incredibly busy so it was likely overlooked in the deluge of work.

Thanks so much, Allison

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: Rainer, Michelle < Michelle.Rainer@dfo-mpo.gc.ca > Sent: Thursday, March 7, 2019 12:53 PM
To: Webb, Allison < Allison.Webb@dfo-mpo.gc.ca > Subject: FW: PRV papers communication summary

Hi Allison, FYI

Issue: Two DFO Science papers on piscine orthoreovirus (PRV) will be published on March 13. The papers are separate but related and will appear in the journals *Frontiers of Physiology* and *Scientific Reports*. DFO funded and co-authored both studies; however, the *Frontiers of Physiology* paper was done in conjunction with UBC and researchers the province of BC's Animal Health Centre contributed to the *Scientific Reports* study. UBC is issuing a press release (attached).

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Proactive Communications: Once they are published, Pacific Region Communications plans to tweet a link to the articles and contact environmental reporters who have been following this story with an offer to interview DFO's Kyle Garver or Mark Polinski, two of the authors of the papers, on these findings. Earlier action is not possible as the papers are under embargo prior to publication.

Tweet:

New DFO research fills in critical knowledge gaps concerning piscine orthoreovirus (PRV) and salmon health.

From: MacDougall, Lesley

Sent: March-11-19 12:31 PM

To: Lowe, Carmel; Kennedy, Eddy; Holmes, John; Salomi, Corino; Webb, Allison

Subject: RE: Teleconference: PRV task team - workplan for responding to 'Namgis decision

Attachments: tablePRV.docx

Hi all:

I've re-attached the table that Allison initiated to help structure our short call today, along with a few extra notes from today's national call:

----Original Appointment----From: MacDougall, Lesley
Sent: March-07-19 10:31 AM

To: MacDougall, Lesley; Lowe, Carmel; Kennedy, Eddy; Holmes, John; Salomi, Corino; Webb, Allison

Subject: Teleconference: PRV task team - workplan for responding to 'Namgis decision

When: March-11-19 12:30 PM-1:00 PM (UTC-08:00) Pacific Time (US & Canada).

Where: ADGT office / teleconference 1-877-413-4782

Hi all - UPDATED start time due to various conflicts...

Before the national train barrels out of the station, a regional check in is advised. My sense from today's call is that a lot of the management side of these q's has already been collated, and within science we will also have summary info for aggregates – we will want to start pulling this information together, so this call is to help us shape how to best articulate what we already have and identify what's still needed (and possible) given the short response time.

To inform the direction on 'harm':

What is the appropriate aggregate unit? – what is the limit of our current information on wild salmon – populations, MU's, CU's, other?

What do we know at that aggregate unit? What is the status (where we have it), what do we use to describe relative success/strength if we don't have status assessments?

How does that aggregate unit intersect with aquaculture and hatchery influences

At what spatial and temporal scale?

What do we currently do to assess 'harm' already in SEP and AMD?

What measures are relevant and currently in place to mitigate 'harm'?

What guidance can sci provide regarding eval of 'harm' with what we already know about risk factors? What are the most common pathogens on farms / in SEP facilities, what is currently done to manage?

s.16(2)(c)

Information That Could Be Collected To Inform Decision Maker regarding Wild Fish/Aquaculture/SEP fish interactions and fish health status and risk to wild salmon as well as aggregates

Current Information Available

Information Type or Nature of Info	Lead to collect / follow up	Other comments	Purpose
PRV Risk Assessment	Jay Parsons	Require a summary of information that can be provided as science advice to the decision maker. Can this information be generalized to be used in other areas in BC? Broughton?	
Farmed fish list of disease agents tested	Allison Webb	Can immediately provide	
SEP fish list of disease agents tested	Corino Salomi	Can immediately provide	
Trends of aqua fish mortalities including disease prevalence over time	AMD	Requires some analysis, but generally readily available through our time series of 10+ years. Need to decide on	
		scope and may focus on broughton Area first. Need to define that in a common way in terms of geographic boundaries. Can also provide info on chinook.	
Trends in SEP fish mortalities including disease prevalence over time	Corino Salomi	Not sure if this is readily available or requires significant analysis	
Information on status of wild stocks particularly	ADM	AMD provided info on GPS coordinates of farms to	
those that are red and yellow listed and their	Science Pac	Science for their consideration	
lifecycle histories, migration routes and overlay vis-à-		Science to conduct work that is time consuming and may	
vis salmon farms		need to scope to Broughton area to start. Would recommend looking at all species, but if pressed for	
		time, chinook could be of a higher priority?	
Information from Kintama and Chrys Neville's work	Science Pac	Pre-publication? Not sure in what form this is currently,	
on timing of salmon migration and time spent by farms		what species are covered?	
Information from Science on Environmental changes that could cause mortality like HAB	Science Pac		
Information from SSHI that provides info on disease profiles in SEP/farmed/wild fish	Science Pac	Pre-publication and would need to be summarized or data provided	

Information on impacts of SEP on wild fish	Science Pac	Not sure if there has been any work done on impacts of
		hatcheries
Information on PRV in primary publications	Science Pac	Primary publications from research outside of SSHI
Information on stock assessment data quality at the	Science Pac	
CU/MU/stock level relative to salmon farms to		
provide advice on the appropriate aggregate		
:		

Future Information that could be included

Information Type of Nature of Info	Lead to collect or propose research to generate	Lead to collect Other comments or propose research to generate	Purpose
RA on other species re PRV?			

Other Relevant Information / Framework Documents etc:

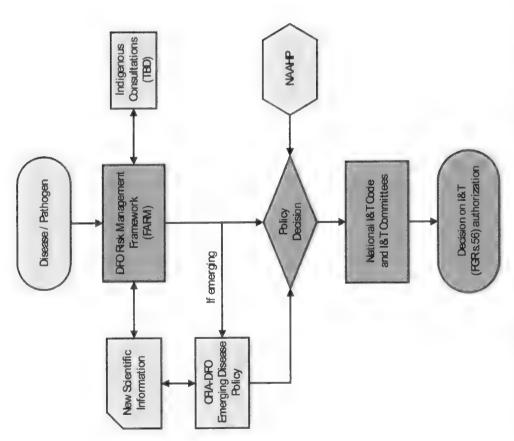
- FARM
- POE and Operational Decision Making Framework for Finfish
- Risk Assessments PRV others?
- Review documents used by decision maker currently re s. 56 licences

SEP questions/ issues - SEP staff working with veterinarian and fish health staff at PBS to consider available information about PRV and provide guidance to:

- Identify if PRV sampling and testing is useful or not and what protocols to apply for various purposes 7:
 - Review fish culture practices to reduce potential blood born sources (a potential PRV source) a. Managing brood stock and blood from egg takes b. Triple rinsing of earn and blood.
- Triple rinsing of eggs pre-incubation
- Review biosecurity measures and fish culture practices to reduce horizontal transmission and consider segregation of groups where testing or risks warrant it က
 - Risk based assessment of stocks and facilities for application of the above items 4.

National / PRV decision response requirements

- What is harm
- Define what level of harm is acceptable
- What mitigation is acceptable
- SEP: is pre-release PRV testing required or not?
- What are the logistical implications
- In the event of positive PRV result what would be required



Proposed articulation of DFO decision making process. The draft CFIA-DFO emerging disease policy is not currently appropriate for DFO Pacific region requirements, and may also create requirements for East coast aquaculture management to address considerations that have a mainly west coast context.

From:

Webb. Allison

Sent:

March-15-19 12:33 PM

To: Cc: Okahori, Karen; Lowe, Carmel; Thomson, Andrew Dickie, Catherine; Barton, Meagan; Delaney, Paula

Subject:

RE: Mar 21 PRV testing Policy WG call

Yes, I'll be there for sure and I'll have some NHQ folks here with me like Matt House of Legal and Jay Parsons from Science. We'll all be working in 401 Burrard on that day and will step out of our meeting to take the call. We'll be in the Killer Whale Boardroom.

Thanks, Allison

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: Okahori, Karen < Karen. Okahori@dfo-mpo.gc.ca>

Sent: Friday, March 15, 2019 12:32 PM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Thomson, Andrew < Andrew.Thomson@dfo-

mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>

Cc: Dickie, Catherine < Catherine. Dickie@dfo-mpo.gc.ca>; Barton, Meagan < Meagan. Barton@dfo-

mpo.gc.ca>; Delaney, Paula <Paula.Delaney@dfo-mpo.gc.ca>

Subject: Mar 21 PRV testing Policy WG call

Would one of you be available for the Mar 21 call? I see you are already on the invite, but will need to advise Philippe's office as RDG will be away on annual leave Mar 19-25.

Let me know. Thanks.

Karen

-----Original Appointment-----

From: Morel, Philippe

Sent: March-15-19 12:14 PM

To: Morel, Philippe; Lowe, Carmel; Reid, Rebecca; Moore, Wayne; Thomson, Andrew; Quinn, Caroline; McPherson, Arran; Webb, Allison; Struthers, Alistair; Haesevoets, Roderick; Sharzer, Stephen (DOJ);

Campbell, John P.

Cc: Krahn, Danielle; Nielsen, Ingrid

Subject: PRV Testing Policy Working Group

When: March-21-19 1:30 PM-2:30 PM (UTC-05:00) Eastern Time (US & Canada).

Where: 10S034 + Teleconference

Feb 25th

s.16(2)(c)

Teleconference Info Dial-in: 1-877-413-4788 Passcode:

From:

Kennedy, Eddy

Sent:

March-18-19 8:24 AM

To:

MacDougall, Lesley; Lowe, Carmel; Holmes, John

Subject:

Re: PRV risk assessment

Feel free to call on my staff as necessary. Reminder that the SOPO meeting is happening this week too.

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "MacDougall, Lesley" < Lesley. MacDougall@dfo-mpo.gc.ca>

Date: 2019-03-18 8:02 AM (GMT-08:00)

To: "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca>, "Holmes, John" < John.Holmes@dfo-mpo.gc.ca>,

"Kennedy, Eddy" < Eddy. Kennedy@dfo-mpo.gc.ca>

Subject: RE: PRV risk assessment

Hi Carmel – I'll work with John on this today. We have scheduled 2 workshops, one on Wednesday, and one on Friday, to ensure we're clear about what data we have, and at what resolution (John has already started that work within his group as well); advance the discussion on threshold of harm and aggregate; and hopefully by Friday, sketch out a draft framework that is reflective of the data and tools we have available at the appropriate resolution.

I see Wayne is asking for a debrief of our progress following those two workshops, sometime in the week of March 25th.

Jay and Ingrid are coming out to participate in person on Wednesday, and potentially by phone on Friday. I will be meeting with them and Allison tomorrow afternoon, and potentially again on Thursday to work through the input we get on Wednesday.

Lesley

s.21(1)(a)

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: March-18-19 7:58 AM

s.21(1)(b) s.23

To: Holmes, John < John. Holmes@dfo-mpo.gc.ca>

Cc: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: PRV risk assessment

John

Accepting that we will use WSP Cu's for Fraser River sockeye, Southern BC chinook and Interior Coho - we need to identify what is the highest resolution unit we have for the other species/other areas of the coast. Who are the people we need to task here - I am unclear if they are in you shop or in Eddy's so cc'ing him. I would like a response on who today and will need to start assigning work and understanding

impacts on other activities soon...

Carmel			
Sent from my BlackBerry	10 smartphone on the Rogers	network.	
	No information has been removed or s	evered from this page	

From: Holmes, John

Sent: March-18-19 9:00 AM

To: Lowe, Carmel; MacDougall, Lesley; Kennedy, Eddy

Subject: RE: PRV risk assessment

We have and we are. As Lesley noted I have requested info on species at different resolutions. Focus is on Broughton Archipelago sites. To date, nothing back but I requested the info by tomorrow.

One issue evaluating harm: our best data are for Fraser sockeye, SBC Chinook and Interior Fraser coho where WSP status assessments have been done at the CU level. WSP assessments are an extremely data intensive process that we have not repeated for other CUs of these species or other species. Most of the CUs with WSP assessments likely migrate past the Broughton sites, which means two windows for exposure. There are more local CUs of these species (e.g., Nimpkish sockeye) that should be considered and there are some CWT indicator stocks - Phillips (in development so likely means we have some information on this stock) and Quinsam (Campbell R), which are not wild but indicators of wild stocks.

For chum and pink the information we have is much sparser and will need to be aggregated at a much higher level. I am not sure that the information is sufficient to conduct a quantitative analysis of harm at this point but Carrie's data-limited methods might be applicable.

John

(250) 756-7145 John.Holmes@dfo-mpo.gc.ca

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: March-18-19 8:12 AM

To: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Holmes, John <John.Holmes@dfo-

mpo.gc.ca>; Kennedy, Eddy < Eddy.Kennedy@dfo-mpo.gc.ca>

Subject: Re: PRV risk assessment

OK thanks - I just needed an assurance that this was being actioned. I have the Wed workshop in my calendar.

Sent from my BlackBerry 10 smartphone on the Rogers network.

From: MacDougall, Lesley

Sent: Monday, March 18, 2019 11:02

To: Lowe, Carmel; Holmes, John; Kennedy, Eddy

Subject: RE: PRV risk assessment

Hi Carmel – I'll work with John on this today. We have scheduled 2 workshops, one on Wednesday, and one on Friday, to ensure we're clear about what data we have, and at what resolution (John has already started that work within his group as well); advance the discussion on threshold of harm and aggregate; and hopefully by Friday, sketch out a draft framework that is reflective of the data and tools we have available at the appropriate resolution.

I see Wayne is asking for a debrief of our progress following those two workshops, sometime in the week of March 25th.

Jay and Ingrid are coming out to participate in person on Wednesday, and potentially by phone on Friday. I will be meeting with them and Allison tomorrow afternoon, and potentially again on Thursday to work through the input we get on Wednesday.

Lesley

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: March-18-19 7:58 AM

To: Holmes, John < John. Holmes@dfo-mpo.gc.ca>

Cc: MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca >

Subject: PRV risk assessment

J	0	h	n

Accepting that we will use WSP Cu's for Fraser River sockeye, Southern BC chinook and Interior Coho - we need to identify what is the highest resolution unit we have for the other species/other areas of the coast. Who are the people we need to task here - I am unclear if they are in you shop or in Eddy's so cc'ing him. I would like a response on who today and will need to start assigning work and understanding impacts on other activities soon...

Carmel

Sent from my BlackBerry 10 smartphone on the Rogers network.

s.21(1)(a)

s.21(1)(b)

s.23

From:

MacDougall, Lesley

Sent: To:

March-18-19 2:11 PM

Rainer, Michelle; Garver, Kyle; Lowe, Carmel

Subject: RE: PRV auestions

Hi Michelle -

I think a number of these questions are similar to ones that were posed during the media technical briefing that followed the PRV risk assessment, that were fielded off-line by comms: have you received any info back yet regarding answers they provided post-meeting to inquiries? Question 9 in particular would have been addressed previously.

For question 3: Additional science work is ongoing:

An ongoing (since 2013) multi-year joint project with DFO/PSF/Genome BC on the distribution and potential impact of a suite of 45 pathogens with a series of publications planned over the coming years; Ongoing research to understand the relationship between different strains of PRV and disease in wild and cultured salmon from Norway and BC.

Similarly the rapid science response question – I know that we've provided communications regarding the purpose of that request and how it differs from science advice, but I don't have the final version of the response.

Lesley

From: Rainer, Michelle < Michelle.Rainer@dfo-mpo.gc.ca>

Sent: March-18-19 1:21 PM

To: Garver, Kyle <Kyle.Garver@dfo-mpo.gc.ca>; MacDougall, Lesley <Lesley.MacDougall@dfo-

mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Subject: FW: PRV questions

Hi again,

Please disregard my previous email. Just want to give more detail and include Carmel.

from the Star Vancouver has sent a number of in-depth questions on PRV for response. I have a lot already from previous inquiries and am coordinating with NHQ as some of the questions are better directed towards them. Please see her full query below (and I'll make sure you see the full response once we've pulled it together) but I have pulled out the questions I'm hoping you can help with (or point me in the right direction). Had to write the numbers out to override autonumbering:

Three: What kind of DFO studies and trials are currently underway regarding PRV and the threat it may pose to wild Pacific salmon?

Four: Are additional CSAS reviews planned to examine the potential threat PRV poses to wild salmon species other than sockeye?

Seven: Further documents show the department ordered a rapid science review of the Di Cicco jaundice paper to determine whether it needed to change its PRV policy. We understand the author of the paper was not involved in this process or informed it was taking place.

- a. Is it standard for the department to exclude the researcher from such review processes? Why don't rapid science reviews follow a similar process as scientific peer reviews?
- b. How was the decision to not amend the PRV policy based on this study consistent with the precautionary principle?

Nine: With regards to the CSAS review of the potential risk of PRV to sockeye:

- a. Why wasn't Di Cicco invited to participate as a local expert?
- b. Why were lab trials that have not yet been through an academic peer review process included in the CSAS review?

Ten: What do you say in response to scientists who say their work has been dismissed by the department and are worried this pattern will continue?

Reporter's deadline is Thursday so would like to have response regionally approved by Wednesday morning.

Thanks, Michelle

From:

Sent: March-18-19 9:45 AM

To: Rainer, Michelle < Michelle.Rainer@dfo-mpo.gc.ca >

Cc:

Subject: PRV questions

Hi Michelle,

and I are working on a feature about PRV and the department's management approach and we have a list of questions we're hoping you can respond to by Thursday end of day. Ideally, we're hoping it will be possible to set up a phone interview with a manager in the aquaculture management division about these questions before then.

FYI we're also sending a separate request for an interview with Minister Wilkinson on this topic.

Please let us know if you have any questions or concerns. You can reach me at

Thanks!

Questions:

- 1. What is the department doing to comply with the Federal Court ruling that said the existing PRV policy doesn't do enough to protect wild salmon from the virus' risks?
- 2. Can you confirm that DFO has refused to allow First Nations in the Broughton Archipelago use of a department lab to test for PRV in fish farms as part of a MOU with the province that allows a First Nations monitoring program? Why?
- 3. What kind of DFO studies and trials are currently underway regarding PRV and the threat it may pose to wild Pacific salmon?

- 4. Are additional CSAS reviews planned to examine the potential threat PRV poses to wild salmon species other than sockeye?
- 5. Critics of DFO's fish farm management approach -- including the Federal Court -- say the department has failed to uphold the precautionary principle. How do you respond to these concerns?
- 6. ATIP documents provided to the Star show DFO has downplayed research from within the department that showed PRV may pose a risk. Emails between DFO aquaculture management, the researchers and the communications officials show DFO amended the press release announcing the Di Cicco HSMI study as a "potential diagnosis" even though the study was later published as a confirmed diagnosis. Emails show industry concerns were taken into account before the press release was amended.
 - 1. Do you acknowledge that there have been confirmed HSMI diagnoses in BC?
 - 2. Why was the press release amended to downplay the diagnosis?
 - 3. Is it normal for industry perspective to be considered in the strategy for communicating science to the public?
- 2. Further documents show the department ordered a rapid science review of the Di Cicco jaundice paper to determine whether it needed to change its PRV policy. We understand the author of the paper was not involved in this process or informed it was taking place.
 - a. Is it standard for the department to exclude the researcher from such review processes? Why don't rapid science reviews follow a similar process as scientific peer reviews?
 - b. How was the decision to not amend the PRV policy based on this study consistent with the precautionary principle?
- 8. To what degree has DFO considered the potential financial harm to industry of preventing PRV-positive salmon smolts from being transferred into ocean pens in its policy decisions?
- 9. With regards to the CSAS review of the potential risk of PRV to sockeye:
 - a. Why wasn't Di Cicco invited to participate as a local expert?
 - b. Why were lab trials that have not yet been through an academic peer review process included in the CSAS review?
- 10. What do you say in response to scientists who say their work has been dismissed by the department and are worried this pattern will continue?

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s.19(1)

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From:

Campbell, John P. March-19-19 5:36 AM

Sent: To:

Krahn, Danielle

Subject:

FW: Debrief - Min brief on PRV

From: Struthers, Alistair

Sent: Thursday, March 14, 2019 3:00 PM

To: Morel, Philippe < Philippe. Morel@dfo-mpo.gc.ca>

Cc: Campbell, John P. <John.Campbell@dfo-mpo.gc.ca>; Richter, Julie <Julie.Richter@dfo-mpo.gc.ca>

Subject: Debrief - Min brief on PRV

A somewhat compressed Min briefing (down from 1hour 30 min to 45). Key points include:

- Kevin presented
- He outlined that two key initiatives are overarching and informing the PRV work: 1) the Framework for Aquaculture Risk Management, and 2) area-based management
- The piece that we are currently working on (and the subject of the briefing) is the development of a standardized decision-making process that informs the movement of fish
- Key questions that are currently being answered, and are needed for this process are:
 - o 1) what is the most appropriate aggregate that will be used (it is not a single fish, nor is it the entire population)?; and
 - o 2) what is the definition and scope of harm (recognizing that this may differ between aggregates, hence the link to area-based management)?
- Directly related to PRV, the final product will likely be a decision note from the RDG (following conversations with the Minister) on whether fish will be transferred, and any associated conditions or mitigation requirements.
- Kevin reiterated that the Department
- The Minister had 2 questions:

 - 2) A memo to Minister is indicated as arriving on March 21 what is this, and what is expected of him by that point?
 - The answer was that this has now changed to a memo to the DM, and that the Minister will be engaged later in April on the decision making framework.
- In conversations with Kevin on this subject over the past 2 days,

Alistair

Alistair Struthers

s.19(1)

Director, Aquaculture Operations
Aquaculture Management Directorate

Fisheries and Oceans / Government of Canada

s.21(1)(a)

s.21(1)(b)

Alistair.Struthers@dfo-mpo.gc.ca / Tel: 613-998-6567

Directeur, Opérations de l'aquaculture Direction générale de la gestion de l'aquaculture Pêches et Océans Canada / Gouvernement du Canada Alistair.Struthers@dfo-mpo.gc.ca / Tél: 613-998-6567

No information has been removed or severed from this page

From:

Krahn, Danielle

Sent:

March-20-19 8:10 AM

To:

House, Matthew (DOJ); Moore, Wayne; Parsons, Jay; Webb, Allison; Campbell, John P.;

Ouinn, Caroline; Martell, D John; Thomson, Andrew; Patirana, Anoma; Haesevoets, Roderick;

Khatkar, Sunita; MacDougall, Lesley; Payne, Brigid

Cc:

Ikejiani, Alexander (DOJ); Levesque, Marie-Pier (DOJ); Burgetz, Ingrid; Lowe, Carmel; Pilcher,

Scott; Nielsen, Ingrid; Salomi, Corino; Fagan, Ashley

Subject:

Attachments:

Hello Everyone,

Many thanks, and apologies for the short turn-around.

Danielle

----Original Appointment----

From: Krahn, Danielle

Sent: Tuesday, March 19, 2019 8:27 AM

To: House, Matthew (DOJ); Moore, Wayne; Parsons, Jay; Webb, Allison; Campbell, John P.; Quinn, Caroline; Martell, D John; Thomson, Andrew; Patirana, Anoma; Haesevoets, Roderick; Khatkar, Sunita;

MacDougall, Lesley; Payne, Brigid

Cc: Ikejiani, Alexander (DOJ); Levesque, Marie-Pier (DOJ); Burgetz, Ingrid; Lowe, Carmel; Pilcher, Scott;

Nielsen, Ingrid; Salomi, Corino; Fagan, Ashley

Subject:

When: Wednesday, March 20, 2019 2:00 PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).

Where: 10N196 + Teleconference

Importance: High

s.21(1)(a)

s.21(1)(b)

s.23

Pages 296 to / à 298 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

From:

Moore, Wayne

Sent:

March-25-19 3:51 AM

To:

Lowe, Carmel; Parsons, Jay

Subject:

FW: Update on PRV risk assessment

Attachments:

PRV Research Pac.docx

Know some of these have come out already. DO we have better timelines on the remaining ones?

----Original Message----

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: November 30, 2018 1:27 PM

To: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Moore, Wayne <Wayne.Moore@dfo-mpo.gc.ca>; McPherson, Arran

<arran.McPherson@dfo-mpo.gc.ca>

Cc: Burgetz, Ingrid <Ingrid.Burgetz@dfo-mpo.gc.ca>; MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: RE: Update on PRV risk assessment

Jay

Attached is a summary of PRV research and associated planned publications for staff in Pacific Region. If you have any questions or require additional information don't hesitate to reach out to Lesley or I.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique

3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7 Carmel.Lowe@dfo-mpo.gc.ca Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

----Original Message----

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: November 15, 2018 7:59 AM

To: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Moore, Wayne <Wayne.Moore@dfo-mpo.gc.ca>; McPherson, Arran

<arran.McPherson@dfo-mpo.gc.ca>

Cc: Burgetz, Ingrid < Ingrid.Burgetz@dfo-mpo.gc.ca>

Subject: Re: Update on PRV risk assessment

Thanks Jay.

The request for updated info from staff here went out last week and I will share once fully compiled. Note PRV work is also underway in other regions (Gagne in Gulf and possibly others?) so a similar request should be sent out to those RDS's.

Carmel

s.21(1)(a) s.21(1)(b)

Sent from my BlackBerry 10 smartphone on the Rogers network.

Original Message

From: Parsons, Jay

Sent: Thursday, November 15, 2018 04:11

To: Moore, Wayne; Lowe, Carmel; McPherson, Arran

Cc: Burgetz, Ingrid

Subject: Update on PRV risk assessment

Hi All,

Very brief update on the risk assessments.

We have just successfully completed the four bacterial risk assessments and will be finalising all the documents in the coming weeks and months.

Our attention is now on the PRV and HSMI complex risk assessment.

The pathogen characterization paper is well developed and during the week of November 19th the we will be meeting with the risk assessment working group in Nanaimo to "workshop" the risk assessment. While it will be necessary to complete some of the analyses after the workshop and complete the writing, the bulk of the work should hopefully be completed at the end of the workshop.

There are still a few critical steps that are necessary to complete this work. The statement of work for the contract for the retrospective analysis still has not progressed. In addition we are still wanting to ensure that the full data set that the department has in its holdings is included in the analyses. This will need to include papers in review, and the supporting data from published studies.

Carmel, if you could please follow up with all Pacific region science staff to request that any relevant and appropriate data, information, publications, pre-publications, etc. related to this topic are provided, that would be greatly appreciated. We are also following up with the ENGOs, FN and industry regarding any supplemental data that they likely have.

Thank you.

Jay

Summary of research and expected publications: (lead: Stewart Johnson)

Activity 1: PRV Genetic Diversity and Phylogenetic Relationships:

Project Team: (BCCAHS), Maureen Purcell (USGS), Nellie Gagne (DFO-Moncton), Rachel Breyta (University of Wash.), Mark Polinski (DFO-Nanaimo), Ken Warheit (Wash. State Dept. Fisheries Wildlife)

We also have linkages with Norwegian and Icelandic research groups.

We are just completing a study of the genetic diversity off and phylogenetic relationships between *PRv1* from different host species and geographical areas over time. We are examining: whether *PRv1* has been spread globally by aquaculture and/or enhancement activities, whether particular genetic variants of *PRv1* are associated with HSMI development, and whether molecular tools which will allow for tracking of *PRv1* transmission between wild and farmed salmonids and non-salmonid reservoir hosts on the West Coast of North America can be developed.

We have obtained whole genome sequences of historical and contemporary PRV isolates from Pacific and Atlantic waters. We are in the process of completing phylogenetic analysis on these sequences and whole genome sequences of Norwegian, Chilean and Canadian *PRv1*. Our goal is to have a manuscript completed for publication early in the New Year.

Tentative Title: PISCINE ORTHOREOVIRUS SUBTYPE 1 (PRv1) FROM FARMED AND WILD SALMONIDS COLLECTED FROM NORTH AMERICAN WATERS: GENETIC DIVERSITY AND PHYLOGENETIC ANALYSIS

We are also working on the development of molecular tools to distinguish between different genetic types of PRV without the need to conduct large-scale sequencing on samples. These tools will be applied to PRV positive samples that we have archived from our ongoing studies. Our goal is to understand spatial and temporal PRV genetic diversity within and between different groups of wild and farmed salmonids.

<u>Activity 2</u>: Identification of Natural Reservoirs of Infection for Pathogens of Concern to Wild and Farmed Salmon in British Columbia - Piscine Orthoreovirus and *Piscirickettsia salmonis*

Project Team: (BCCAHS), (BCSFA), Lenora Turcotte (DFO-Nanaimo) The PRV activities within this project are closely linked to a project that is examining PRV in farmed fish and the environment (see update on "Project #1" from PBS Virology Program below).

In this study, we are examining wild non-salmonid finfish and juvenile and adult wild salmon for the presence of infectious agents of interest (Psal and PRV). Fish have been collected within, as well as away from areas of salmon farming on the West and East Coasts of Vancouver Island. Samples are being obtained from farm bi-catch, DFO research surveys and industry field programs and collections of frozen fish that have been archived from previous field programs.

As part of this project, we have retained PRV and Psal positive samples, especially from non-salmonid finfish, for genetic analysis which will be conducted outside of this project (Activity 1).

We are continuing to monitor the prevalence of PRV in:

- 1. spawning Chinook Salmon from SEP facilities
- 2. juvenile Coho and Chinook Salmon prior to release from SEP facilities.
- 3. juvenile Pacific Salmon caught in the Strait of Georgia and Lower Johnstone Strait. This includes testing of archived samples from areas where PRV has been reported as being present in published studies.
- 4. Non-salmonid finfish collected from within, as well as away from PRV positive farm sites

The data we have obtained will be provided to support a PRV Risk Assessment which is being undertaken by the department.

Summary of research and expected publications: PBS Virology Program (leads: Kyle Garver, Mark Polinski)

<u>Project #1:</u> Prevalence and transmission dynamics of PRV in the marine environment DFO Project team: Mark Polinski, Jon Richard, Haley Matkin, Lynden Gross Collaborators: (Cermag Canada) and British

Columbia Centre for Aquatic Health Sciences (BC-CAHS)

Goal: Determine the marine reservoir(s) of PRV, how the virus is transmitted, and what the transmission rates are within and around net-pen aquaculture

Funding agencies: Aquaculture Collaborative Research and Development Program (ACRDP) and British Columbia Salmon Farmers Association Marine Environmental Research Program (BCSFA-MERP).

Update: The project began in FY2017/2018. We are currently analysing Atlantic Salmon samples across thirteen farms to understand the temporal occurrence of PRV infections on farms. Current data reveals that all farms sampled became PRV infected within 100-200 days post seawater entry. We will be analyzing water and benthic samples to understand potential mechanisms of viral spread. We are also holding Atlantic salmon at the Brandon Island experimental farm facility and monitoring for PRV infection. To date, these fish remain negative for PRV. Experimental challenges to determine minimum infectious dose and shedding rates will begin in 2019.

Project #2: Investigation of piscine reovirus (PRV) in the development of disease

DFO Project team: Mark Polinski, Jon Richard

Collaborators: Center for Aquaculture Technologies Canada (CATC), Marine Harvest, DFO-Gulf

Fisheries Center (GFC), Norwegian University of Life Sciences **Goal:** Identifying disease determinants of PRV infections

Funding agency: Program for Aquaculture Regulatory Research (PARR)

Update: The project began in FY2016/2017 in an effort to understand the basis for why PRV in Norway causes heart and skeletal muscle inflammation (HSMI) while PRV from British Columbia has failed to cause HSMI. Through collaboration with Espen Rimstad at the Norwegian University

of Life Sciences, Canadian and Norwegian PRV isolates have been exchanged and side-by-side challenge studies have been conducted. Preliminary results suggest that the regional difference in virulence is likely attributed to both host-specific and virus strain-specific factors. Additional laboratory challenges (one conducted in Canada and one in Norway) will be performed in 2019 and will involve a pairwise comparison of multiple Atlantic salmon stocks and multiple PRV strains.

<u>Project #3:</u> Determine the physiological consequences of PRV infections in Atlantic salmon and Sockeye salmon

DFO Project team: Mark Polinski, Jon Richard

Collaborators: Anthony Farrell (UBC), Colin Brauner (UBC), Yangfan Zhang (UBC), Phillip Morrison

Goal: Determine if PRV infections cause measurable physiological changes in salmon

Funding agency: Program for Aquaculture Regulatory Research (PARR)

Update: The project was completed in 2017/2018 and one paper has been submitted and one is in preparation. The results from these studies revealed that the oxygen affinity and carrying capacity of erythrocytes was unaffected by PRV despite the presence of severe viremia, minor heart pathology and transient cellular activation of antiviral response pathways. Similarly, PRV-infected fish had no sustained nor appreciable differences in respiratory capabilities compared with control fish. The lack of functional harm to salmon infected with PRV in this instance highlights that, in an era of unprecedented virus discovery, detection of viral infection does not necessarily imply bodily harm and that viral load is not always a suitable predictor of disease within a host organism.

Submitted PRV paper:

Zhange, Y., Polinski, M.P., Morrison, P.R., Brauner, C.J., Farrell, A.P., Garver, K.A. (2018) High-load piscine orthoreovirus infections do not imply physiological impairment in Atlantic salmon. Frontiers in Physiology (Submitted)

PRV Paper in prep.:

Polinski, M.P., Zhange, Y., Morrison, P.R., Brauner, C.J., Farrell, A.P., Garver, K.A. (2019) PRV infections of Sockeye salmon do not result in a physiological consequence (in preparation, note the title may change).

Project #4: Determine the transmission potential of HSMI in Atlantic salmon

DFO Project team: Mark Polinski, Jon Richard, Haley Matkin

Collaborators: Grieg Seafoods

Goal: Determine if the disease HSMI is transmissible to naïve fish **Funding agency:** Program for Aquaculture Regulatory Research (PARR)

Update: This project was completed in 2017/2018 and one paper has been submitted. This study investigated PRV infection dynamics and the potential for experimental passage of HSMI in Pacific-adapted Mowi-McConnell Atlantic salmon to better understand the mechanisms for PRV-associated pathogenesis. Regardless of the PRV source (non-diseased or HSMI-diseased fish), infections led to viremia that induced only minor focal heart inflammation without significant transcriptional induction of inflammatory cytokines. Repeated screening of PRV dsRNA/ssRNA along with histopathology and gene expression analysis of host blood and heart tissues identified

three distinct phases of infection: (1) early systemic dissemination and replication without host recognition; (2) peak replication, erythrocyte inclusion body formation and load-dependent host recognition; followed by (3) long-term, high-load viral persistence with limited replication or host recognition sometimes accompanied by minor heart inflammation. These findings contrast previous PRV challenge trials that induced HSMI in multiple regards, and suggest that secondary requirements may be necessary to initiate PRV-associated disease.

Submitted PRV paper:

Polinski, M.P., Marty, G., Snyman, H., Garver, K.A. (2018) Successful passage of PRV but not HSMI in Mowi-McConnell Atlantic salmon suggests secondary requirements for initiating PRV-associated disease. Scientific Reports (Submitted)

<u>Project #5:</u> Evaluating the role of PRV in development of Erythrocytic Inclusion Body Syndrome (EIBS)

DFO Project team: Mark Polinski

Collaborators: Western Fisheries Research Center, United States Geological Survey (USGS)

Goal: Determine if the PRV causes EIBS

Funding agency: Priorities and Partnership fund

Update: This study is being performed by Maureen Purcell in Seattle at the Western Fisheries Research Center. One challenge has been completed and subsequent studies are underway. Preliminary results showed that the BC–PRV obtained from Atlantic salmon failed to cause EIBS. Nevertheless, PRV positive material collected from an EIBS case was able to recreate EIBS in naïve fish. Consequently, additional work is being conducted to tease out what role (if any) PRV plays in this disease condition.

Summary of research and expected publications with some relevance to PRV: Strategic Salmon Health Initiative Molecular Genetics Program (lead: Kristi Miller-Saunders)

Note that the SSHI is broad-based when it comes to infectious agents, and PRV is one of dozens of agents that we are studying. While there are some projects/papers that focus specifically on PRV, the in the vast majority of cases, we present data on PRV in the context of patterns across all agents.

Project #1:

DFO Project team: Kristi Miller, Karia Kaukinen

Collaborators: UPEI (Thakur, Vanderstichel, Nekouei, Laurin)

Goal: To determine what newly identified agents were detectable in archived sockeye liver samples dating back to the mid-1980s, before the expansion of the Atlantic salmon aquaculture industry in BC.

Funding Agency: Pacific Salmon Foundation; Genome BC

Update: The range of infective agents detected in historic sockeye salmon livers was highly overlapping with those detected in smolt and adult salmon today, including known endemic agnets (Flavobacterium psychrophilum, Infectious hematopoetic necrosis virus, Ceratonova shasta, and Parvicapsula minibicornis, Kudoa thyrsites and Piscirikettsia salmonis, Loma salmonae, Ichthryoponus hoferi, Ichtyroptherius multifilis, Dermocystidium salmonis, Renibacterium salmoninarum, Tetracapsuloides bryosalmonae, Myxobolus arcticus, Nucleospora

salmonis, Aeromonas salmonicida, Yersinia ruckeri, Rickettsia-like organism) and agents only described recently in BC salmon (Ca. Branchiomonas cysticola, Parvicapsula pseudobranchicola, Paranucleospora theridion, Sphaeothecum destruens, Piscichlamydia salmonis, Parvicapsula kabatai, Pacific Salmon Parvovirus), suggesting that there has not been substantial change in the composition of agents in the 30 years since the Atlantic salmon aquaculture industry expanded, although the study did not speak to shifts in prevalence. There were, however, a few agents not detected in these historic samples, including PRV. The study did not go so far as to suggest that these data definitively establish the absence of PRV in BC in the mid 1980's, but its absence in the 652 samples surveyed across multiple drainages suggest that if it was present, it was at a very low level, at least in sockeye salmon.

Key Points:

 PRV was one of the few agents present now but not detected in sockeye salmon samples from 1985-1992

Manuscripts/papers: Thakur KK, R Vanderstichel, K *Kaukinen, O *Nekouei, E *Laurin, KM Miller. Infectious agent detections in archived Sockeye salmon (*Oncorhynchus nerka*) samples from British Columbia (1985-1994). FACETS: In Revision. (likely a month away from publication)

Project #2:

DFO Project team: Kristi Miller, Strahan Tucker, Tobi Ming, Karia Kaukinen, Amy Tabata

Collaborators: UPEI (Thakur, Vanderstichel, Nekouei, Laurin)

Goal: To describe for the first time the full range of infectious agents detected in

Funding Agency: Pacific Salmon Foundation; Genome BC

Update/Abstract: Infectious diseases are likely contributors to declines in Fraser River Sockeye salmon (Oncorhynchus nerka) stocks, but a clear knowledge gap exists around which infectious agents and diseases are important. This study was undertaken to: 1) determine the presence, prevalence, and burden of 46 infectious agents in juvenile Fraser River Sockeye salmon, and 2) evaluate spatial patterns in prevalence and burden over initial seaward migration, contrasting patterns between two years of average and poor productivity. Overall, 2,006 out-migrating Sockeye salmon were collected from four regions along their migration trajectory in British Columbia, in 2012 and 2013. High-throughput microfluidics quantitative PCR was employed for simultaneous quantitation of 46 infectious agents. Twenty-six agents were detected at least once, including nine with prevalence >5%. Candidatus Brachiomonas cysticola, Myxobolus arcticus, and Pacific salmon parvovirus were the most prevalent agents. Infectious agent diversity and burden increased consistently upon smolts entry into the ocean. Notably, both freshwater- and saltwater-transmitted agents were more prevalent in 2013 than in 2012, leading to an overall higher infection burden in the first two sampling regions. A reduction in the prevalence of two agents, erythrocytic necrosis virus and Paranucleospora theridion, was observed between regions 2 and 3, which was speculated to be associated with mortality during the first month at sea. The most prevalent infectious agents were all naturally occurring. However, in a small number of samples, seven agents were only detected post exposure to salmon farms, including four established farm pathogens: piscine orthoreovirus, Piscirickettsia salmonis, Tenacibaculum maritimum, and Moritella viscosa.

Key points:

- Higher agent diversity and burden in year of poor ocean survival (2013) than in year of good survival; Erythrocytic Necrosis Virus stands out as strongest differential
- Only a few agents detected after sockeye salmon migrate through Discovery-Johnstone Strait; PRV among them

Manuscripts/papers: *Nekouei O, R. Vanderstichel, T *Ming, KH *Kaukinen, K *Thakur, A *Tabata, E *Laurin, S *Tucker, KM Miller. Spatio-temporal burden of infectious agents in juvenile Fraser River Sockeye salmon (two years of average and poor productivity). Frontiers in Microbiology: In Revision. (likely a month or two away from publication)

Project #3:

DFO Project team: Kristi Miller, Tobi Ming,

Collaborators: UBC (Hinch, Wang), Pacific Salmon Foundation (Emiliano Di Cicco)

Goal: To explore evidence for physiological impact of agents infecting Chinook salmon that show truncated prevalence/load distributions that may indicate impacts on survival in the early marine residence period. Physiological variation explored at the molecular (gene expression), protein (blood serum), and cellular (histopathology) levels.

Funding Agency: Pacific Salmon Foundation; Genome BC

Update/Abstract: The role of infectious diseases in the declining productivity of wild Chinook salmon (Oncorhynchus tshawytscha) in BC is poorly understood. In wild populations, it is difficult to study the effects of infectious diseases because they interact with environmentally induced stress and diseased fish are not often observed as many are likely predated upon or die out of view. The early marine life of Pacific salmon is believed to be one of the key components to the declining populations. More focus on understanding the potential role of infectious agents during this life period is needed. The current study assessed how infectious agents are associated with the physiology of migrating juvenile Chinook salmon upon their entry of marine water by linking ancillary data, physiological responses and histopathological lesions with infectious agent detection results. It is one of the first to study infectious agents carried by wild salmon through combining molecular, protein, and cellular levels of fish physiology information. Among 46 assayed infectious agent taxa, 26 were detected including viruses, bacteria, and parasites. Fish from Columbia River system were found to have significantly higher infection burden than five other populations. We discovered and reported the associations between fish physiological conditions and five infectious agents, including Ichthyophonus hoferi, 'Candidatus Branchiomonas cysticola', Parvicapsula minibicornis, Ceratonova shasta, and Piscine orthoreovirus (PRV). PRV, particularly, was recently reported in many salmon farms in BC as the suspected causal agent of two related diseases among Atlantic salmon and Chinook salmon, and has potential to be exchanged between farmed and wild populations. We provided one of the first evidence of potential impacts of PRV both on host genes and histopathology in the wild juvenile Chinook salmon.

Key Points:

• First evidence of potential impacts of PRV both on host gene activation and histopathology in wild juvenile Chinook salmon

Manuscripts/papers: Wang Y, Hinch SG, ass AL, Li S, Ming TJ, DI Cicco E, Miller KM. In prep. The physiological impacts of infectious agents on migrating juvenile Chinook salmon (*Oncorhynchus tshawytscha*). (likely >4 months to publication)

Project #4:

DFO Project team: Kristi Miller, Karia Kaukinen

Collaborators: Atlantic Salmon Federation (, UBC (Teffer)

Goal: To identify the range of infective agents detected in migratory Atlantic salmon in eastern Canada (Bay of Fundy region) and Greenland. Samples in the Bay of Fundy were returning adult salmon and in Greenland were European and North American origin sub-adults; genetic stock identification confirmed their continent of origin.

Funding Agency: Pacific Salmon Foundation; Genome BC

Update/Abstract: This study is still being analysed and written up. Some findings of interest include: PRV detections from European and North American Greenland-collected fish as well as in one river system where all wild fish had been extirpated and replaced with all farmed escapees. PRV genome sequencing shows that the two Greenland fish carried nearly identical sequences of PRV, despite their origin from different continents. This may imply transmission where North American and European stocks converge. In some segments of the virus, the phylogenetically closest samples come from the west coast of Canada, in others they are more similar to Norwegian variants; these data are still being considered for interpretation. This study showed a high prevalence of both Atlantic Salmon Calicivirus (first time detected on the east coast of Canada) and PRV, and overall infectious profiles similar to farmed Atlantic salmon in the Pacific ocean. Noted, first detection of Pavicapsula pseudobranchicola, Paranucleospora theridion, and Piscichlamydia salmonis in Eastern Canada. Salmon Gill pox virus was also detected in the Magaguadavic population. There was a report about the detection of this highly pathogenic virus in Atlantic salmon from New Brunswick in a 2017 Gill Health Workshop Proceedings, but there are no peer reviewed publications on its presence. This virus has not been detected in Western Canadian fish. Other agents detected were largely known to occur in Eastern Canadian salmon, although this would be the first description of some in wild fish

Key Points:

- PRV detected and genome sequenced in two fish sampled in Greenland and in escaped farmed salmon; will show phylogenetic relationship with PRV from around the world.
- As in BC, PRV is highly prevalent in farmed salmon

Manuscripts/papers: Teffer AK, Miller KM, G, Kaukinen, KH. Infectious agent profiles of wild and farmed Atlantic salmon in the Bay of Fundy and migratory salmon in Greenland. In Prep (~ 1 month to a submission ready manuscript)

s.19(1)

Project #5:

DFO Project team: Kristi Miller, Angela Schulze, Shaorong Li, Amy Tabata,

Collaborators: Pacific Salmon Foundation (Di Cicco)

Goal: Establish whether PRV-containing blood from Atlantic salmon sampled during an outbreak

of HSMI can cause disease in Chinook salmon

Funding Agency: Pacific Salmon Foundation; Genome BC

Update/Abstract: Completion of PRV challenge study on juvenile Chinook salmon shows that PRV derived from blood taken during an Atlantic salmon farm outbreak of HSMI is capable of causing red blood cell lysis and early stages of disease development (including tissue lesions and clinical signs of disease) associated with jaundice/anemia in Chinook salmon, data that are consistent with and complementary to the recent Di Cicco et al. 2018 publication in FACETS. We intend to repeat this study with virus purified from fish used in this study to challenge younger Chinook salmon at a lower temperature, more consistent with conditions under which jaundice/anemia occurs in farmed salmon.

Key Points: PRV transmitted from diseased farmed Atlantic salmon can induce the typical early lesions seen in jaundice/anemia in Chinook salmon. While there was no resultant jaundice or necrosis of kidney tubules observed, red blood cell lysis and anemia did occur. We hypothesize that kidney tubule necrosis and jaundice occur in the final stages of the disease if, and only if there is a toxic overload of hemoglobin at levels high enough to destroy kidney tubules.

Manuscripts/papers: Not begun writing yet, but soon.

Project #6:

DFO Project team: Kristi Miller, Angela Schulze, Shaorong Li, Amy Tabata,

Collaborators: Pacific Salmon Foundation (Di Cicco)

Goal: Establish whether PRV-containing blood from Atlantic salmon sampled during an outbreak

of HSMI can cause disease in Chinook salmon

Funding Agency: Pacific Salmon Foundation; Genome BC

Update/Abstract: Completion of PRV challenge study on juvenile Chinook salmon shows that PRV derived from blood taken during an Atlantic salmon farm outbreak of HSMI is capable of causing red blood cell lysis and early stages of disease development (including tissue lesions and clinical signs of disease) associated with jaundice/anemia in Chinook salmon, data that are consistent with and complementary to the recent Di Cicco et al. 2018 publication in FACETS. We intend to repeat this study with virus purified from fish used in this study to challenge younger Chinook salmon at a lower temperature, more consistent with conditions under which jaundice/anemia occurs in farmed salmon.

Key Points: PRV transmitted from diseased farmed Atlantic salmon can induce the typical early lesions seen in jaundice/anemia in Chinook salmon. While there was no resultant jaundice or necrosis of kidney tubules observed, red blood cell lysis and anemia did occur. We hypothesize that kidney tubule necrosis and jaundice occur in the final stages of the disease if, and only if there is a toxic overload of hemoglobin at levels high enough to destroy kidney tubules.

Manuscripts/papers: Not begun writing yet, but soon.

Project #7:

DFO Project team: Kristi Miller, Angela Schulze, Shaorong Li, Amy Tabata, Karia Kaukinen, Tobi Ming

Collaborators: UPEI (Thakur, Nekouei, Vanderstichel), UBC (Teffer, Bass), Pacific Salmon Foundation

Goal: To examine the explanatory power of infectious agents profiles on estimates of ocean survival (smolt to adult including downstream migration) and spawner-recuit analysis in juvenile sockeye, Chinook and coho salmon sampled in the early marine environment.

Funding Agency: Pacific Salmon Foundation; Genome BC

Update/Abstract: Manuscripts are being developed using infectious agent and stock assessment data spanning 7-10 years for each species, and including years with extreme variation in year-class strength. PRV is not the specific focus, but is among the agents that will be examined. **Key Points:** The primary objective of the Strategic Salmon Health Initiative was to determine what role, if any, infectious disease may play as a factor in salmon declines, and these studies are highly important to our ability to address this issue.

Manuscripts/papers: Not begun writing yet, but analysis is ongoing.

Proiect #8:

DFO Project team: Kristi Miller, Angela Schulze, Karia Kaukinen

Collaborators: Pacific Salmon Foundation (

Goal: Determine the differences in infectious burdens (prevalence and load) between live- and moribund/dead-sampled farmed Atlantic salmon over their entire ocean production cycle. Update/Abstract: The risk of infectious agent transmission between farmed and wild salmon is dependent upon multiple factors, including the overall infective burden within a farm population. For agents causing acute disease, we expect that high infective burdens will be temporally sporadic, and higher in moribund/dead fish than the in the general populations, although there are exceptions to this. Alternatively, we expect agents that are opportunistic or cause chronic diseases to be more tolerated, and hence more dispersed across the farm population, including both live- and moribund/dead fish. This research is exploring burden patterns across 50 infective agents in live- and moribund/dead-sampled fish from four farms. PRV is not the specific focus, but is one of the agents.

Key Points: One objective of the Strategic Salmon Health Initiative was to determine which agents posed the highest risk of transmission between farmed and wild fish, and this research is central (but not exclusive) to that question.

Manuscripts/papers: Not begun writing yet, but analysis is ongoing.

Project #9:

DFO Project team: Kristi Miller, Angela Schulze, Karia Kaukinen

Collaborators: UBC (Suttle, Mordecai, Joy)

Goal: Phylogenetic analysis of PRV based on whole viral genome sequencing to determine 1) the transmission pathways of the virus between wild/hatchery origin migratory and farmed salmon, 2) to assess the role viral quasispecies (high genetic variation within a host) may play in risk of disease development.

Update/Abstract: PRV from ~150 freshwater and marine sampled farmed (healthy and diseased) and wild salmon (Chinook, Coho, Sockeye, Pink and Chum salmon juveniles) from BC and Washington stocks is currently undergoing high throughput sequencing for full genome sequence data. Farmed fish include those sampled from 2011-2013 through the audit program

(>20 farms), as well as longitudinal sampled from four farms, one of which underwent a full outbreak of HSMI and a second with only a small number of affected individuals. Approximately 15 full PRV viral genomes have been sequenced to date, and many other partial genomes. Key Points: This work is being undertaken to identify viral factors that may be associated with disease (e.g., high quasi-species diversity) and transmission dynamics in BC salmon. Manuscripts/papers: Not begun writing yet, but a MSc thesis on viral quasi-species is underway and full planning for sequencing is completed.

Project #9:

DFO Project team: Kristi Miller, Angela Schulze, Karia Kaukinen

Collaborators: UBC (Suttle, Mordecai, Joy)

Goal: Phylogenetic analysis of PRV based on whole viral genome sequencing to determine 1) the transmission pathways of the virus between wild/hatchery origin migratory and farmed salmon, 2) to assess the role viral quasispecies (high genetic variation within a host) may play in risk of disease development.

Update/Abstract: PRV from ~150 freshwater and marine sampled farmed (healthy and diseased) and wild salmon (Chinook, Coho, Sockeye, Pink and Chum salmon juveniles) from BC and Washington stocks is currently undergoing high throughput sequencing for full genome sequence data. Farmed fish include those sampled from 2011-2013 through the audit program (>20 farms), as well as longitudinal sampled from four farms, one of which underwent a full outbreak of HSMI and a second with only a small number of affected individuals. Approximately 15 full PRV viral genomes have been sequenced to date, and many other partial genomes. Key Points: This work is being undertaken to identify viral factors that may be associated with disease (e.g. high quasi-species diversity) and transmission dynamics in BC salmon. Manuscripts/papers: Not begun writing yet, but a MSc thesis on viral quasi-species is underway

and full planning for sequencing is completed.

Dickie, Catherine

From:

Lowe, Carmel

Sent:

March-26-19 4:14 PM

To:

Rainer, Michelle

Cc:

MacDougall, Lesley

Subject:

RE: Media inquiry on PRV & HSMI

Thanks Michelle - appreciate you keeping me in the loop on this.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel Lowe@dfo-mpo.qc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

From: Rainer, Michelle < Michelle.Rainer@dfo-mpo.gc.ca>

Sent: March 26, 2019 4:09 PM

To: Lowe, Carmel < Carmel, Lowe@dfo-mpo.gc.ca>

Cc: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: Media inquiry on PRV & HSMI

Hi Carmel,

Just want to make sure you are aware of a media inquiry from the Vancouver Star. The reporter has interviewed some of our scientists (Kyle Garver, Lesley and probably Kristi Miller-Saunders) as well as the Minister and has a number of detailed questions for the department. The response is being coordinated in NHQ but just wanted to let you know that I provided input that was approved by you (and then all the way up to MINO) last year in another request with similar questions. I have attached the draft for your reference (tracked changes are mine) and an email with reporter's questions. I believe they plan to send the response tomorrow; please let me know if you have any concerns and I will pass them on.

Regards, Michelle

Dickie, Catherine

From: House, Matthew < Matthew. House@justice.gc.ca>

Sent: March-28-19 2:13 PM

To: Krahn, Danielle; Moore, Wayne; Parsons, Jay; Thomson, Andrew; Webb, Allison; Patirana,

Anoma; Khatkar, Sunita; MacDougall, Lesley; Payne, Brigid; Quinn, Caroline; Martell, D John; Ikejiani, Alexander (DOJ); Levesque, Marie-Pier (DOJ); Lowe, Carmel; Burgetz, Ingrid; Pilcher,

Scott; Salomi, Corino; Fagan, Ashley; Jenkins, Phil

Cc: Nielsen, Ingrid; Medeiros, Dean; Haesevoets, Roderick; Struthers, Alistair

Subject:

Danielle,			

Matt

From: Krahn, Danielle [mailto:Danielle.Krahn@dfo-mpo.gc.ca]

Sent: Thursday, March 28, 2019 1:30 PM

To: House, Matthew <Matthew.House@justice.gc.ca>; Moore, Wayne <Wayne.Moore@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Patirana, Anoma <Anoma.Patirana@dfo-mpo.gc.ca>; Khatkar, Sunita <Sunita.Khatkar@DFO-MPO.GC.CA>; MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Payne, Brigid <Brigid.Payne@dfo-mpo.gc.ca>; Quinn, Caroline <Caroline.Quinn@dfo-mpo.gc.ca>; Martell, D John <John.Martell@dfo-mpo.gc.ca>; Ikejiani, Alexander <Alexander.Ikejiani@justice.gc.ca>; Lévesque, Marie-Pier <Marie-Pier.Levesque@justice.gc.ca>; Lowe,

Carmel <Carmel.Lowe@dfo-mpo.gc.ca>; Levesque, Marie-Pier <Marie-Pier.Levesque@justice.gc.ca>; Lowe Carmel <Carmel.Lowe@dfo-mpo.gc.ca>; Burgetz, Ingrid <Ingrid.Burgetz@dfo-mpo.gc.ca>; Pilcher, Scott <Scott.Pilcher@dfo-mpo.gc.ca>; Salomi, Corino <Corino.Salomi@dfo-mpo.gc.ca>; Fagan, Ashley <Ashley.Fagan@dfo-mpo.gc.ca>; Jenkins, Phil <Phil.Jenkins@dfo-mpo.gc.ca>

Cc: Nielsen, Ingrid < Ingrid.Nielsen@dfo-mpo.gc.ca>; Medeiros, Dean < Dean.Medeiros@dfo-mpo.gc.ca>; Haesevoets, Roderick < Roderick. Haesevoets@dfo-mpo.gc.ca>; Struthers, Alistair

s.21(1)(a) s.21(1)(b)

<Alistair.Struthers@dfo-mpo.gc.ca>
Subject:

s.21(1)(b) s.23

Importance: High

Hello Everyone,

Many thanks, Danielle

Danielle Krahn

Analyst / Analyste
Fisheries and Oceans Canada / Ministère des Pêches et Océans
Aquaculture Management / La gestion de l'aquaculture
200 Kent Street / 200, rue Kent
Ottawa, Ontario K1A 0E6

s.16(2)(c)

Telephone / Téléphone:

No further information has been removed or severed from this page

Pages 314 to / à 315 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

Dickie, Catherine

From: Webb, Allison

Sent: March-28-19 2:41 PM

To: Nielsen, Ingrid; Krahn, Danielle Cc: Lowe, Carmel; Parsons, Jay

Subject: FW: PRV assessment aggregates, current draft - includes initial information for all species

Attachments: Preliminary 2019 Salmon Outlook_PRV Assessment - Broughton_v3.docx

For the meeting tomorrow -

My apologies, I didn't see this in my overflowing in box until about an hour ago so didn't integrate it into the updated document on aggregates. If there is still time to include as a separate document, we could reference this and speak to it. If it isn't too late, I could revise the aggregates document. In either case, it should be fine, but I would like Science to get the credit for having turned this around so incredibly quickly. Amazing work!

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Sent: Wednesday, March 27, 2019 10:56 AM

To: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca> Subject: FW: PRV assessment aggregates, current draft - includes initial information for all species

Hi Allison and Jay;

Here is the current draft of assessment of biological state at the level of finest resolution possible based on available data.

Preliminary Assessment of Biological State of Pacific Salmon

March 2019

This assessment aims to provide an assessment of biological state at the finest resolution possible, based on available data. At the finest scale, biological status is available at the Conservation Unit level (CU) for some species, in some areas. Under the Wild Salmon Policy (WSP), CUs are defined as "a group of wild salmon sufficiently isolated from other groups that, if extirpated, is very unlikely to recolonize naturally within an acceptable timeframe" (DFO 2005). In cases where data is not collected at this scale, the unit of assessment is the Outlook Unit level (where Outlook Units are aggregates of CUs; see Appendix 1 for a table cross-referencing Outlook Units to Conservation Units).

With respect to assessing risks associated with pathogen transfer, exposure factors have also been compiled for each unit of assessment. These include:

- Proximity of natal stream to area of interest: closer proximity is associated with increased probability of exposure due to suspected periods of residence in/near area of interest (as outmigrating juvenile and/or returning adult);
- Juvenile migration route and timing (mitigated by migration speed, residence periods during early marine phase, interannual variation in timing); and
- Adult migration route and timing (mitigated by diversion rates, seasonality of migration, interannual variation in timing and/or diversion rates).

Commentary for each unit of assessment includes consideration of the following questions (in cases where the unit of assessment is deemed relevant to the area of interest):

- What do we know at that aggregate unit?
- What is the status (where we have it)?
- What do we use to describe relative success/strength if we don't have status assessments?
- How often is the status assessed?
- Notes about data quality over the available time series.

Metrics to Assess Biological Status

Where available, results of integrated biological status assessments under the Wild Salmon Policy (WSP) are provided (see DFO 2015 (Coho), 2016 (Chinook), 2018 (Sockeye) for detailed descriptions of these methods). For populations where WSP integrated biological status assessments are not available, the following simple metrics have been compiled to inform biological status at the finest scale of aggregation possible, based on available data:

• Recent generational mean spawner abundances relative to the long-term median. Where exploitation rates are low to moderate (<40%), productivity is moderate to high, and time-series are relatively long (>20 years), then the median and 25th percentile of historic spawner abundances can be used to define red, amber, and green zones of status as applied for WSP assessments. Otherwise, this information can be used simply to identify long-term trends (increasing or decreasing). Where data are not available in the most recent generation, the most recent 3 generations can be used. If data are not available in the most recent 3 generations, the population aggregate would be data deficient on this metric.

- Three generation (or 10 years for pink and coho salmon) trends in spawner abundances relative to COSEWIC thresholds for at-risk designations (30% decline).
- The number of CUs with status in the red zone or indicating poor status based on the two metrics above (applies only to scales of aggregation greater than a CU).

To assess risks of pathogens to wild *returning* (mature) fish, long-term trends in returns may be relevant as well (recent generational average relative to long-term median). These data are typically available only at relatively large scales of aggregation (e.g., management unit or statistical area), with the exception of stocks were WSP assessments have already been completed.

The Department is continuing to assess benchmarks of biological status under the WSP for CUs of Pacific salmon. This information will be added to this assessment as it becomes available.

Contributors:

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	EXP AOI: Bi	Exposure Assessment AOI: Broughton Archinelago	nent inelaso	
Aggregate Unit (Outlook Unit/CU/Other)	Proximate Natal Stream	Juvenile Migration	Adult Migration	Commentary
Sockeye				
1. Okanagan-Osoyoos	δ	°N	ν̈́	Not relevant to Broughton Archipelago area of interest. This population enters marine waters via the Columbia River and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
Fraser Sockeye - Overview				
Each year, a portion of the returning	Fraser Sockeye	Salmon populati	on diverts their n	Each year, a portion of the returning Fraser Sockeye Salmon population diverts their migration route to follow the west coast of Vancouver Island
(called the "Diversion Rate"). This	is estimated pre-s	eason and then	updated througho	(called the "Diversion Rate"). This is estimated pre-season and then updated throughout the spawning migration period. Higher diversion rates
are suspected to result in decreased exposure of these populations differences in diversion rate that are not well estimated at present	exposure of these	populations thre	ough the area of	are suspected to result in decreased exposure of these populations through the area of interest, although there could be population-specific differences in diversion rate that are not well estimated at present.
Adult migration timing differs amon exposure profile of each groun throu	ig the four run ting the area of interest of the area	ning groups (ear	ly Stuart, early sugon the seasonal	Adult migration timing differs among the four run timing groups (early Stuart, early summer, summer, late) which may alter the respective exposure profile of each group through the area of interest (depending on the seasonality of pathogen transfer and overall migration behaviour).
2. Early Stuart (CU: Takla-Trembleur-Early Stuart)	No	Ѕоте	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: RED (DFO 2018).
3. Early Summer – North Thompson (CU: North Barriere-ES)	Š	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: AMBER (DFO 2018).
4. Early Summer South Thompson (CU: Shuswap-ES)	No	Ѕоте	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: AMBER (DFO 2018).
5. Early Summer – Mid & Upper Fraser (4 CUs: Anderson-Seton-ES; Nadina-Francois-ES; Bowron-ES; Taseko-ES)	°Z	Some	Some	WSP assessments for these CUs conducted in 2010 and 2017. Current integrated biological status is: two AMBER-GREEN, two RED (DFO 2018).
6. Early Summer – Lower Fraser (3 CUs: Pitt-ES; Chilliwack-ES; Nahatlach-ES)	Š.	Some	Some	WSP assessments for these CUs conducted in 2010 and 2017. Current integrated biological status is: one GREEN, one AMBER-GREEN, one AMBER (DFO 2018).
7. Summer – Chilko (CUs: Chilko-S; Chilko-ES)	No	Some	Some	WSP assessments for these CUs conducted in 2010 and 2017. Current integrated biological status is: one GREEN, one Data Deficient (DFO 2018).

	Exp	Exposure Assessment	hent	
	AOI: Br	i: Broughton Archipelago	upelago	
Aggregate Unit	Proximate	Juvenile	Adult	
Outlook Unit/CU/Other)	Natal Stream	Migration	MIGRATION	Соппениту
8. Summer – Late Stuart (CUs: Takla-Trembleur-Stuart-S)	No	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: RED-AMBER (DFO 2018).
9. Summer – Nechako (CU: Francois-Fraser-S)	N _O	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: AMBER-GREEN (DFO 2018).
10. Summer – Quesnel (CU: Quesnel-S)	No	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: RED-AMBER (DFO 2018).
94. Summer-Harrison (CU: Harrison-River Type; Widgeon-River Type)	No	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: one GREEN, one RED (DFO 2018).
95. Summer-Raft (CU: Kamloops-ES)	No	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: AMBER (DFO 2018).
11. Fall – Cultus (CU: Cultus-L)	No	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: RED (DFO 2018).
12. Fall – Portage (CU: Seton-L)	No	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: RED (DFO 2018).
13. Fall – South Thompson (CU: Shuswap-L)	No	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: AMBER-GREEN (DFO 2018).
14. Fall – Birkenhead (CU: Lillooet-Harrison-L)	No	Some	Some	WSP assessments for the CU conducted in 2010 and 2017. Current integrated biological status is: AMBER (DFO 2018).
15. Fall – Lower Fraser CUs: Harrison (U/S)-L; Harrison (D/S)-L)	No	Some	Some	WSP assessments for these CUs conducted in 2010 and 2017. Current integrated biological status is: one AMBER-GREEN, one RED (DFO 2018).

	Exp. AOI: Br	Exposure Assessment I: Broughton Archipelago	ipelago	
Aggregate Unit (Outlook Unit/CU/Other)	Proximate Natal Stream	Juvenile Migration	Adult Migration	Commentary
Non-Fraser Sockeye				
16. Somass	No	°Z	No No	Not relevant to Broughton Archipelago area of interest. This population enters marine waters on the west coast of Vancouver Island and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
17. Henderson	°Z	No	No	Not relevant to Broughton Archipelago area of interest. This population enters marine waters on the west coast of Vancouver Island and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
18. WCVI - Other	N	Š	No	Not relevant to Broughton Archipelago area of interest. This population enters marine waters on the west coast of Vancouver Island and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
19. Areas 11 to 13	Yes	Some	Some	Populations from Area 11 are not expected to migrate through the area of interest. Juvenile studies of some lake systems in/near the area of interest have been conducted in the past (Hyatt to review and add more information).
20. Sakinaw	No	Yes	Yes	Sakinaw Lake sockeye salmon live and spawn in Sakinaw Lake and its watershed, located northwest of Vancouver on the Sechelt Penninsula. The fish migrate to the ocean through Johnstone Strait in mid-June to late July. The Sakinaw Lake sockeye salmon is designated as endangered by COSEWIC. In January 2005, a final decision was made by the Government of Canada to not list Sakinaw Lake sockeye salmon under the Species at Risk Act (SARA), due to the significant socio-economic impacts on sockeye fishers and coastal communities. The spawner estimate in 2018 was 3 fish (4-yr average: 340; 12-yr average: 233) (DFO 2019).
21. Areas 7 to 10	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.

	Exp AOI: Bi	Exposure Assessment I: Broughton Archipelago	nent uipelago	
Aggregate Unit (Outlook Unit/CU/Other)	Proximate Natal Stream	Juvenile Migration	Adult Migration	Commentary
22. Coastal Areas 3 to 6	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the north and central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
23. Babine Lake - Enhanced	N ₀	N _O	Š.	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the north coast of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
24. Skeena - Wild	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the north coast of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
25. Nass	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the north coast of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
26. Haida Gwaii	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters on Haida Gwaii and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
27. Alsek	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
28. Stikine - Wild	N _O	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
29. Taku - Wild	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.

	T S	Funcenta Accesement		
	AOI: Br	f: Broughton Archipelago	ipelago	
Aggregate Unit (Outlook Unit/CU/Other)	Proximate Natal Stream	Juvenile Migration	Adult Migration	Commentary
Chinook				
101. Okanagan	ν̈́	N _o	%	Not relevant to Broughton Archipelago area of interest. This population enters marine waters via the Columbia River and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
96. Fraser River Spring Run 42 CUs: South Thompson-Bessette Creek_SU_1.2; Lower Thompson_SP_1.2	N _O	Some	Yes	WSP assessments for these CUs were conducted in 2014. Current integrated biological status is: two RED (DFO 2016).
97. Fraser River Spring Run 52 CUs: Lower Fraser River SP 1.3; Lower Fraser River-Upper Pitt_SU_1.3; Middle Fraser-Fraser Canyon_SP 1.3; Middle Fraser River_SP 1.3; Upper Fraser River_SP 1.3; North Thompson_SP 1.3	No	Some	Yes	WSP assessments for these CUs conducted in 2014. Current integrated biological status is: three RED, one To Be Determined, two Data Deficient (DFO 2016).
98. Fraser River Summer Run 52 CUs: Middle Fraser River- Portage_FA_1.3; North Thompson_SU_1.3; South Thompson_SU_1.3; Middle Fraser River_SU_1.3; Lower Fraser River_SU_1.3	No	Some	Yes	WSP assessments for these CUs conducted in 2014. Current integrated biological status is: two RED, one RED-AMBER, one AMBER, one Data Deficient (DFO 2016).
99. Fraser River Summer Run 4 ₁ CUs: South Thompson_SU_0.3; Shuswap River_SU_0.3; Upper Adams River_SU_x.x; Maria Slough_SU_0.3	Ν̈́ο	No	Unk	WSP assessments for these CUs conducted in 2014. Current integrated biological status is: one GREEN, two To Be Determined (DFO 2016). Evidence of this population found off the west coast of Vancouver Island in the fall following juvenile ocean entry suggesting at least some proportion of this population does not migrate through the area of interest (REF?).

	Exp	Exposure Assessment	nent.	
	AOI: Br	: Broughton Archipelago	upelago	
Aggregate Unit	Proximate	Juvenile	Adult	
(Outlook Unit/CU/Other)	Natal Stream	Migration	Migration	Commentary
100. Fraser River Fall Run 4 ₁ CUs: Lower Fraser River_SU_1.3	°N	Some	Some	WSP assessments for these CUs conducted in 2014. Current integrated biological status is: GREEN (provisional) (DFO 2016). Consistent declines in annual spawner abundance in the years since the WSP assessment have led to increasing concern about the current state of this population.
39. WCVI – Hatchery	No	N _O	N ₀	Not relevant to Broughton Archipelago area of interest. This population enters marine waters on the west coast of Vancouver Island and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
40. WCVI-Wild	No	No	No	Not relevant to Broughton Archipelago area of interest. This population enters marine waters on the west coast of Vancouver Island and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
41. Johnstone Strait Area (including mainland inlets) CUs: East Vancouver Island-North_FA_0.x; Homathko_SU_x.x; Klinkaklini_SU_1.3; Southern Mainland-Southern Fjords_FA_0.x	Yes	Yes	Yes	WSP assessments for these CUs conducted in 2014. Current integrated biological status is: one RED, three Data Deficient (DFO 2016). Escapement data in 2018 shows the following (DFO 2019), all from one CU: Sliammon Creek 108 (4-yr avg: 56, 12-yr avg: 108) Theodosia River 52 (4-yr avg: 63, 12-yr avg: 46) Chapman Creek 18 (4-yr avg: NA, 12-yr avg: 60)
42. Georgia Strait Fall (wild and small hatchery operations) CUs: Boundary Bay_FA_0.3; East Vancouver Island-Cowichan & Koksilah_FA_0.x; East Vancouver Island-Nanaimo & Chemainus_FA_0.x; East Vancouver Island-Goldstream_FA_0.x	Some	Some	Some	WSP assessments for these CUs conducted in 2014 determined all were To Be Determined, pending an approach to dealing with hatchery contributions to CUs (DFO 2016). Populations from southern Georgia Strait (Goldstream, Cowichan) likely do not migrate through the area of interest. Escapement data in 2018 shows the following (DFO 2019): Nanaimo 1484 (4-yr avg: 4092, 12-yr avg: 3929) Chemainus 79 (4-yr avg: 98, 12-yr avg: 300)

		Exposure Assessment	ent 	
•		: Broughton Archipelago	ripelago	
Aggregate Unit	Proximate	Juvenile	Adult	
(Outlook Unit/CU/Other)	Natal Stream	Migration	Migration	Commentary
43. Georgia Strait Fall (large hatchery				WSP assessment for this CU conducted in 2014 To Be Determined, pending an approach to dealing with hatchery contributions to CUs (DFO 2016).
operations) CUs: East Vancouver Island-Qualicum & Puntledge_FA_0.x	Some	Some	Some	Escapement data in 2018 shows the following (DFO 2019): Big Qualicum 6507 (4-yr avg: 6727, 12-yr avg: 7682) Puntledge 10673 (4-yr avg: 8623, 12-yr avg: 7174) Englishman 411 (4-yr avg: 1052, 12-yr avg: 856) Little Qualicum 2922 (4-yr avg: 4777, 12-yr avg: 4476)
44. Georgia Strait Spring and Summer CUs: East Vancouver Island-Nanaimo SP 1 v. Vancouver	Ž	Ѕоте	Some	WSP assessments for these CUs conducted in 2014 determined one Data Deficient, one To Be Determined, pending an approach to dealing with hatchery contributions to CUs (DFO 2016). Populations from southern Georgia Strait (Chemainus) may not migrate through the area of interest.
Island-Georgia Strait_SU_0.3				Escapement data in 2018 shows the following (DFO 2019): Puntledge 820 fish (4-yr avg: 855, 12-yr avg: 1078) Nanaimo 288 (4-yr avg: 850, 12-yr avg: 788) Chemainus 12 (4-yr avg: 32, 12-yr avg: 32)
45. Areas 7 and 8	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
46. Areas 9 and 10	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
47. Coastal Areas 3 to 6	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the north and central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
48. Nass	N _O	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the north coast of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.

	Exp AOI: Bi	Exposure Assessment AOI: Broughton Archipelago	nent nipelago	
Aggregate Unit (Outlook Unit/CU/Other)	Proximate Natal Stream	Juvenile Migration	Adult	Commentary
49. Haida Gwaii	No	N _o	N ₀	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters on Haida Gwaii and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
50. Skeena	No	%	N ₀	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the north coast of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
51. Alsek	No	Š	SZ.	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
52. Stikine	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
53. Taku	No	Ν̈́o	N _O	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
54. Yukon	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the Yukon and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
Coho				
102. Interior Fraser CUs: Middle Fraser, Fraser Canyon, Lower Thompson, North Thompson, South Thompson.	°Z	Some?	Some?	WSP assessments for these CUs conducted in 2014. Current integrated biological status is: three AMBER, two AMBER/GREEN (DFO 2015).

	Exp AOI: Bi	Exposure Assessment: Broughton Archipelago	nent ipelago	
Aggregate Unit (Outlook Unit/CU/Other)	Proximate Natal Stream	Juvenile Migration	Adult Migration	Commentary
57. Lower Fraser	N	Some?	Some?	Coho populations spawn throughout the Fraser watershed, with many spawning sites in Lower Fraser River. Generally a streamtype life history with most returning as three-year olds. Coho enter the Lower Fraser River from late August to December.
58. WCVI	No	No	N ₀	Not relevant to Broughton Archipelago area of interest. This population enters marine waters on the west coast of Vancouver Island and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
59. Area 12	Yes	Yes	Yes	Wild Coho Indicator Stock (Keogh River in PFMA 12) monitor smolt outmigration and adult escapement. CWTs applied to this system. Relative abundance is used as a surrogate of status for the Indicator Stock but not the Assessment Unit as a whole. Status for Assessment Unit is not determined.
60. Area 13 - North	Yes	Yes	Yes	Wild Coho Indicator Stocks (Black Creek in PFMA 13) monitor smolt outmigration and adult escapement. CWTs applied to this system. Relative abundance is used as a surrogate of status for the Indicator Stock but not the Assessment Unit as a whole. Status for Assessment Unit is not determined.
61. Georgia Strait	Some	Some	Some	In 2018, escapement estimates were generated for 23 systems in this assessment unit (DFO 2019, Table 2). Nine were above both their 4- and 12-yr average escapements. Six were below both their 4- and 12-yr average escapements. The remaining eight were either approximately the same as their 4- and 12-yr averages or had incomplete information.
62. Areas 7 to 10	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.

	Exp AOI: Br	Exposure Assessment: Broughton Archinelago	nent nipelago	
Aggregate Unit	Proximate Notel Stream	Juvenile	Adult	Commentary
63. Areas 5 and 6	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the north and central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
64. Area 3	No	No	N _o	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the north and central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
65. Haida Gwaii - E (Area 2 East)	No	No	Š	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters on Haida Gwaii and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
66. Haida Gwaii - N (Area 1)	No	N ₀	Š	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters on Haida Gwaii and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
67. Haida Gwaii - W (Area 2 West)	No	No	Š	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters on Haida Gwaii and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
68. Skeena	No	N N	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the north coast of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
69. Skeena – High Interior	N O	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the north coast of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
70. Alsek	N _O	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.

	Exp AOI: Br	Exposure Assessment Exposure Assessment	nent nipelago	
Aggregate Unit		Juvenile	Adult	Commonweater
	Nicolar Strange	M.S.	TONETRI	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region
71. Sukine	0	o Z	<u>0</u>	of BC and the migration pathways (juvemile and adult) are assumed to be outside the area of interest.
72. Taku	N _O	No	%	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
73. Yukon	No	No	Š	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the Yukon and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
Pink				
74. Fraser - Odd only CU: Fraser River	°Z	Yes?	Yes?	Primarily an odd-year run, there were very few fish observed in the Fraser in 2018.
75. Squamish - Odd only CU: East Howe Sound-Burrard Inlet	No	Yes?	Yes?	Primarily an odd-year run, there were very few fish observed in Georgia Strait in 2018 (DFO 2019, Table 5).
76. WCVI - Odd & Even	No	No	N _o	Not relevant to Broughton Archipelago area of interest. This population enters marine waters on the west coast of Vancouver Island and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
77. Areas 11 to 13 - Odd & Even CUs: Southern Fjords (odd and even), Homathko-Klinaklini; East Coast Vancouver Island – Johnstone Strait, Nahwitti	Yes	Yes	Yes	In Area 12, escapement monitoring was extensive prior to 2015, but has been minimal since. Currently, some stream walkers from Echo Bay cover a few smaller streams in the area. Catch data is available in odd years from PSC with Inner South Coast Pink salmon broken out which can then be apportioned to the various other CUs. Data infilling required for the escapement time series to deal with gaps in monitoring. Catch in even years assumed to be all non-Fraser and can be apportioned based on escapement to the PFMA or CU (DFO 2017).

	Exp AOI: Br	Exposure Assessment AOI: Broughton Archipelago	nent nipelago	
Aggregate Unit (Outlook Unit/CU/Other)	Proximate Natal Stream	Juvenile Migration	Adult Migration	Commentary
78. Georgia Strait - West - Odd & Even	Some	Some	Some	Primarily an odd-year run, there were few fish observed in Georgia Strait in 2018 (DFO 2019, Table 5). Of five systems surveyed in 2018, all five were well below their even year three generation average.
				Run reconstruction and abundance trend information is available for this CU (DFO 2017).
79. Georgia Strait - East - Odd & Even	Some	Some	Some	Primarily an odd-year run, there were very few fish observed in Georgia Strait in 2018 (DFO 2019, Table 5). Of two systems surveyed in 2018, one was below its even year three generation average and the other had incomplete information.
				Run reconstruction and abundance trend information is available for this CU (DFO 2017).
80. Areas 7 to 10 - Odd & Even	No	No	N _O	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
81. North Coast Areas 3 to 6 - Odd & Even	No	N _O	Š	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the north and central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
82. Haida Gwaii - Even	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters on Haida Gwaii and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
Chum				
83. Fraser River (CUs: Fraser Canyon and Lower Fraser)	°Z	Some	Some	Largest chum population in British Columbia. Return to the Fraser River from September through November. In recent years, the peak migration is mid/late-October. Major spawning areas are below Hope: Harrison/Weaver/Chehalis, Chilliwack/Vedder, Stave. Some levels of hatchery enhancement over the past ten or more years.
				TANK CONTRACT TRATICALS TO SEE SOLL

	Exp AOI: Ry	Exposure Assessment	ient inelson	
Aggregate Unit	Proximate	Juvenile	Adult	
84. WCVI	No	No	°N	Not relevant to Broughton Archipelago area of interest. This population enters marine waters on the west coast of Vancouver Island and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
85. Johnstone Strait Area and Mainland Inlets (Areas 11 to 13)	Yes	Yes	Yes	In Area 12, escapement monitoring was extensive prior to 2015, but is minimal since. Currently some stream walkers from Echo Bay cover a few smaller streams in the area.
86. Georgia Strait	Some	Yes	Yes	In 2018, escapement estimates were generated for 28 systems in this assessment unit (DFO 2019, Table 3). Two were above both their 4- and 12-yr average escapements. Nineteen were below both their 4- and 12-yr average escapements. The remaining seven were either approximately the same as their 4- and 12-yr averages or had incomplete information.
87. Coastal Areas 5 & 6	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the north and central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
88. Haida Gwaii	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters on Haida Gwaii and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
89. Skeena-Nass	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the north coast of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
90. Areas 7 to 10	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters along the central mainland BC coast and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.

	Exp AOI: Br	Exposure Assessment AOI: Broughton Archipelago	nent uipelago	
Aggregate Unit (Outlook Unit/CU/Other)	Proximate Natal Stream	Juvenile Migration	Adult Migration	Commentary
91. Yukon (mainstem)	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the Yukon and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
92. Yukon (Porcupine)	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the Yukon and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.
93. Taku	No	No	No	Not relevant to Broughton Archipelago area of interest. Populations in this outlook unit enter marine waters in the transboundary region of BC and the migration pathways (juvenile and adult) are assumed to be outside the area of interest.

References

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- DFO. 2016. Integrated Biological Status of Southern British Columbia Chinook Salmon (Oncorhynchus tshawytscha) Under the Wild Salmon Policy. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/042.
- DFO 2017. Inner South Coast Pink Stock Reconstructions (1953-2016): Escapement and Total Stock Reconstructions by Conservation Units. South Coast Stock Assessment, Fisheries and Oceans Canada, 3225 Stephenson Point Road, Nanaimo, BC. August 10, 2017. p.31. Unpublished data, available upon request.
- DFO 2018. The 2017 Fraser Sockeye Salmon (Oncorhynchus nerka) integrated biological status re-assessment under the Wild Salmon Policy. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2018/017.
- DFO. 2019. South Coast Salmon Bulletin #12 Escapement Update. Strait of Georgia Stock Assessment, Fisheries and Oceans Canada, 3225 Stephenson Point Road, Nanaimo, BC. January 2, 2019. p.9. Unpublished data, available upon request.

Appendix 1. Outlook Units and associated Conservation Units.

OU No.	Outlook Unit Name	Conservation Unit
Sockeye	(Sockeye CU types: SEL = lake type	e, SER = river type)
1	Okanagan	SEL::Osoyoos
2	Early Stuart	SEL::Takla/Trembleur-Early Stuart timing
3	Early Summer – North Thompson	SEL::North Barriere-Early Summer timing
4	Early Summer – South Thompson	SEL::Shuswap-Early Summer timing
5	Early Summer – Mid and Upper	SEL::Anderson/Seton-Early Summer timing
	Fraser	SEL::Bowron-Early Summer timing
		SEL::Chilko-Early Summer timing
		SEL::Francois-First Run-Early Summer timing
		SEL::Francois-Second Run-Early Summer timing
		SEL::Indian/Kruger-Early Summer timing
		SEL::Nadina/Francois-Early Summer timing
		SEL::Taseko-Early Summer timing
6	Early Summer - Lower Fraser	SEL::Chilliwack-Early Summer timing
		SEL::Nahatlatch-Early Summer timing
		SEL::Pitt-Early Summer timing
7	Summer – Chilko	SEL::Chilko-Summer timing
8	Summer – Late Stuart	SEL::Takla/Trembleur/Stuart-Summer timing
9	Summer – Nechako	SEL::Francois/Fraser-Summer timing
10	Summer – Quesnel	SEL::Quesnel-Summer timing
94	Summer – Harrison (new)	SER::Harrison River
		SER::Widgeon Creek
95	Summer – Raft (new)	SEL::Kamloops-Early Summer timing
11	Fall – Cultus	SEL::Cultus-Late timing
12	Fall - Portage	SEL::Seton-Late timing
13	Fall – South Thompson	SEL::Shuswap Complex-Late timing
14	Fall -Birkenhead	SEL::Lillooet/Harrison-Late timing
15	Fall – Lower Fraser	SEL::Harrison-downstream migrating-Late timing
		SEL::Harrison-upstream migrating-Late timing
16	Somass	SEL::Great Central
		SEL::Sproat
17	Henderson	SEL::Henderson
18	WCVI – Other	SEL::Alice
		SEL::Canoe Creek
		SEL::Cecilia
		SEL::Cheewat
		SEL::Clayoquot
		SEL::Deserted
		SEL::Fairy
		SEL::Hesquiat
		SEL::Hobiton
		SEL::Jansen
		SEL::Kanim
i		SEL::Kennedy
		SEL::Maggie
		SEL::Megin
		SEL::Muchalat
		SEL::Muriel
		SEL::Nitinat

OU No.	Outlook Unit Name	Conservation Unit
		SEL::O'Connell
		SEL::Owossitsa
		SEL::Park River
		SEL::Power
		SEL::William/Brink
19	Areas 11 to 13	SEL::Fulmore
		SEL::Heydon
		SEL::Ida/Bonanza
		SEL::Kakweiken
		SEL::Loose
		SEL::Mackenzie
		SEL::Nahwitti
		SEL::Nimpkish
		SEL::Pack
		SEL::Phillips
		SEL::Quatse
		SEL::Schoen
		SEL::Shushartie
		SEL::Tzoonie
		SEL::Vernon
		SEL::Village Bay
		SEL::Woss
20	Sakinaw	SEL::Sakinaw
21	Areas 7 to 10	SEL::Long
		SEL::Owikeno
		SEL::Owikeno-Late timing
		SEL::South Atnarko Lakes
		SEL::Wannock[Owikeno]
22	Coastal Areas 3 to 6	SEL::Backland
		SEL::Banks
		SEL::Bloomfield
		SEL::Bolton Creek
		SEL::Bonilla
		SEL::Borrowman Creek
		SEL::Busey Creek
		SEL::Canoona
		SEL::Cartwright Creek
		SEL::Chic Chic
		SEL::Curtis Inlet
		SEL::Dallain Creek
		SEL::Deer
		SEL::Devon
		SEL::Dome
		SEL::Douglas Creek
		SEL::Elizabeth
		SEL::Elsie/Hoy
		SEL::End Hill Creek
		SEL::Evelyn
		SEL::Evinrude Inlet
		SEL::Fannie Cove
		SEL::Freeda/Brodie
		SEL::Hartley Bay

OU No.	Outlook Unit Name	Conservation Unit
		SEL::Hevenor Inlet
		SEL::Higgins Lagoon
		SEL::Kadjusdis River
		SEL::Kainet Creek
		SEL::Kdelmashan Creek
		SEL::Keecha
		SEL::Kent Inlet Lagoon Creek
		SEL::Kenzuwash Creeks
		SEL::Keswar Creek
		SEL::Kildidt Creek
		SEL::Kildidt Lagoon Creek
		SEL::Kimsquit
		SEL::Kisameet
		SEL::Kitkiata
		SEL::Kitlope
		SEL::Koeye
		SEL::Kooryet
		SEL::Kunsoot River
		SEL::Kwakwa Creek
		SEL::Lewis Creek
		SEL::Limestone Creek
		SEL::Lowe/Simpson/Weare
		SEL::Mary Cove Creek
		SEL::Mcdonald Creek
		SEL::Mcloughlin
		SEL::Mikado
		SEL::Monckton Inlet Creek
		SEL::Namu
		SEL::Pine River
		SEL::Port John
		SEL::Powles Creek
		SEL::Price Creek
		SEL::Prudhomme
		SEL::Roderick
		SEL::Ryan Creek
		SEL::Salter
		SEL::Scoular/Kilpatrick
		SEL::Shawatlan
		SEL::Sheneeza Inlet
		SEL::Ship Point Creek
		SEL::Sockeye Creek
		SEL::Spencer Creek
		SEL::Stannard Creek
		SEL::Talamoosa Creek
		SEL::Tankeeah River
		SEL::Treneman Creek
		SEL::Tsimtack Lakes
		SEL::Tuno Creek East
		SEL::Tuno Creek West
		SEL::Tuwartz
		SEL::Tyler Creek
		SEL::Wale Creek

U No.	Outlook Unit Name	Conservation Unit
		SEL::Watt Bay
		SEL::West Creek
		SEL::Whalen
		SEL::Yaaklele Lagoon
		SEL::Yeo
23	Babine Lake – Enhanced	SEL::Babine
24	Skeena – Wild	SEL::Alastair
		SEL::Aldrich
		SEL::Asitika
		SEL::Atna
		SEL::Azuklotz
		SEL::Bear
		SEL::Clements
		SEL::Damshilgwit
		SEL::Dennis
		SEL::Ecstall/Lower
		SEL::Footsore/Hodder
		SEL::Johanson
		SEL::Johnston
		SEL::Joiniston SEL::Kitsumkalum
		SEL::Kitwancool
		SEL::Kluatantan
		SEL::Kluayaz
		SEL::Lakelse
		SEL::Maxan
		SEL::Mcdonell
		SEL::Morice
		SEL::Motase
		SEL::Nilkitkwa
		SEL::Sicintine
		SEL::Slamgeesh
		SEL::Spawning
		SEL::Split Mountain/Leverson
		SEL::Stephens
		SEL::Sustut
		SEL::Swan
		SEL::Tahlo/Morrison
25	Nass	SEL::Bowser
		SEL::Bulkley
		SEL::Damdochax/Wiminasik
		SEL::Fred Wright
		SEL::Kwinageese
		SEL::Meziadin
		SEL::Oweegee
26	Haida Gwaii	SEL::Ain/Skundale/Ian
20		SEL::Awun
		SEL::Fairfax
		SEL::Jalun
		SEL::Marian/Eden
		SEL::Marie
		SEL::Mathers

OU No.	Outlook Unit Name	Conservation Unit
		SEL::Skidegate
		SEL::Yakoun
27	Alsek	SEL::Blanchard
		SEL::Klukshu
		SEL::Neskatahin
28	Stikine – Wild	SEL::Christina
		SEL::Chutine
		SEL::Tahltan
29	Taku – Wild	SEL::King Salmon
		SEL::Kuthai
		SEL::Little Trapper
		SEL::Tatsamenie
61.		
Chinool	K	
101	Okanagan	CK::Okanagan
96	Fraser River Spring Run 42	CK::South Thompson-Bessette Creek
-		CK::Lower Thompson-spring timing-age 1.2
97	Fraser River Spring Run 52	CK::Lower Fraser River-spring timing
		CK::Lower Fraser River-Upper Pitt
		CK::Fraser Canyon-Nahatlatch
		CK::Middle Fraser River-spring timing
		CK::Upper Fraser River-spring timing
		CK::North Thompson-spring timing-age 1.3
98	Fraser River Summer Run 5 ₂	CK::Lower Fraser River-summer timing
		CK::Middle Fraser River-Portage
		CK::Middle Fraser River-summer timing
		CK::South Thompson-summer timing-age 1.3
		CK::North Thompson-summer timing-age 1.3
99	Fraser River Summer Run 4 ₁	CK::Maria Slough
		CK::South Thompson-summer timing-age 0.3
		CK::Shuswap River-summer timing-age 0.3
		CK::Upper Adams River_su_1.x
100	Fraser River Fall Run 4 ₁	CK::Lower Fraser River-fall timing (white)
		(P)Hatchery Exclusion-Lower Fraser River
39	WCVI - Hatchery	includes production from major hatchery facilities at Conuma, Stamp,
		and Nitinat rivers
40	WCVI – Wild	CK::Nootka and Kyuquot
		CK::Northwest Vancouver Island
		CK::Southwest Vancouver Island
41	Johnstone Strait Area (including	CK::Homathko
	mainland inlets)	CK::Klinaklini
		CK::Northeast Vancouver Island
		CK::South Coast-southern fjords
42	Georgia Strait Fall (wild and small	CK::Boundary Bay
	hatchery operations)	CK::East Vancouver Island-Cowichan and Koksilah
		CK::East Vancouver Island-Goldstream
		CK::East Vancouver Island-Nanaimo and Chemainus-fall timing
		CK::South Coast-Georgia Strait
43	Georgia Strait Fall (large hatchery	CK::East Vancouver Island-Qualicum and Puntledge-fall timing
	operations)	
44	Georgia Strait Spring and Summer	CK::Vancouver Island-Georgia Strait_su_0.3
		CK::East Vancouver Island-Nanaimo-spring timing

OU No.	Outlook Unit Name	Conservation Unit
45	Areas 7 and 8	CK::Bella Coola-Bentinck
		CK::Dean River
46	Areas 9 and 10	CK::Docee
		CK::Rivers Inlet
		CK::Wannock
47	Coastal Areas 3 to 6	CK::North and Central Coast-early timing
.,		CK::North and Central Coast-late timing
		CK::Portland Sound-Observatory Inlet-Lower Nass
		CK::Skeena Estuary
48	Nass	CK::Upper Nass
49	Haida Gwaii	CK::Haida Gwaii-East
.,		CK::Haida Gwaii-North
50	Skeena	CK::Ecstall
		CK::Kalum-early timing
		CK::Kalum-late timing
		CK::Lakelse
		CK::Lower Skeena
		CK::Middle Skeena-large lakes
		CK::Middle Skeena-mainstem tributaries
		CK::Sicintine
		CK::Upper Bulkley River
		CK::Upper Skeena
		CK::Zymoetz
51	Alsek	CK::Alsek
52	Stikine	CK::Stikine-early timing
32	Stiking	CK::Stikine-late timing
53	Taku	CK::Taku-early timing
		CK::Taku-late timing
		CK::Taku-mid timing
54	Yukon	CK::Big Salmon
"		CK::Middle Yukon River and tributaries
		CK::Nordenskiold
		CK::Northern Yukon River and tributaries
		CK::Old Crow
		CK::Pelly
	}	CK::Porcupine
		CK::Salmon Fork
		CK::Stewart
		CK::Upper Yukon River
		CK::White and tributaries
		CK::Yukon River-Teslin headwaters
G 1	.1	
Coho		
102	Interior Fraser	CO::Fraser Canyon
	 Mid and Upper – Fraser 	CO::Middle Fraser
	- Thompson	CO::Lower Thompson
		CO::North Thompson
		CO::South Thompson
57	Lower Fraser	CO::Lillooet
		CO::Lower Fraser-A
		CO::Lower Fraser-B

OU No.	Outlook Unit Name	Conservation Unit
58	WCVI	CO::Clayoquot
		CO::Juan de Fuca-Pachena
		CO::West Vancouver Island
59	Area 12	CO::Homathko-Klinaklini Rivers
		CO::Nahwitti Lowland
60	Area 13 – North	CO::East Vancouver Island-Johnstone Strait-Southern Fjords
	1 2 4 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	CO::Southern Coastal Streams-Queen Charlotte Strait-Johnstone
		Strait-Southern Fjords
61	Georgia Strait	CO::Boundary Bay
"		CO::East Vancouver Island-Georgia Strait
		CO::Georgia Strait Mainland
		CO::Howe Sound-Burrard Inlet
62	Areas 7 to 10	CO::Bella Coola-Dean Rivers
02	Alcas / to To	CO::Rivers Inlet
		CO::Smith Inlet
63	Areas 5 and 6	CO::Brim-Wahoo
03	Alcas 5 and 6	CO::Douglas Channel-Kitimat Arm
		CO::Hecate Strait Mainland
		CO::Mussel-Kynoch
		CO::Northern Coastal Streams
64	Area 3	CO::Lower Nass
04	Area 3	CO::Portland Sound-Observatory Inlet-Portland Canal
		CO::Skeena Estuary
	Y :1 G :: E ://A AE ()	CO::Upper Nass CO::Haida Gwaii-East
65	Haida Gwaii – East (Area 2 East)	
66	Haida Gwaii – North (Area 1)	CO::Haida Gwaii-Graham Island Lowlands
67	Haida Gwaii - West (Area 2 West)	CO::Haida Gwaii-West
68	Skeena	CO::Lower Skeena
		CO::Middle Skeena
69	Skeena – High Interior	CO::Upper Skeena
70	Alsek	CO::Alsek River
71	Stikine	CO::Lower Stikine
72	Taku	CO::Taku-early timing
		CO::Taku-late timing
		CO::Taku-mid timing
73	Yukon	CO::Porcupine
Pink (Pin	nk CU types: PKO = odd year, PKE =	even year)
74	Fraser - Odd only	PKO::Fraser River
75	Squamish - Odd only	PKO::East Howe Sound-Burrard Inlet
76	WCVI - Odd & Even	PKE::Northwest Vancouver Island
		PKE::West Vancouver Island
		PKO::West Vancouver Island
77	Areas 11 to 13 - Odd & Even	PKE::Southern Fjords
		PKO::Nahwitti
		PKO::Southern Fjords
		PKO::East Vancouver Island-Johnstone Strait
78	Georgia Strait - West - Odd &	not yet defined; includes some seapen releases
/ 0	Even	Too) or marriam, warman sowin cambon revenue
79	Georgia Strait – East – Odd & Even	PKE::Georgia Strait
13	Georgia Buait - Last - Oud & Even	PKO::Georgia Strait
	<u></u>	1 INO. GOOLEIN OHILL

OU No.	Outlook Unit Name	Conservation Unit
80	Areas 7 to 10 - Odd & Even	PKE::Hecate Lowlands
		PKE::Hecate Strait-Fjords
		PKO::Hecate Strait-Fjords
		PKO::Hecate Strait-Lowlands
		PKO::Homathko-Klinaklini-Smith-Rivers-Bella Coola-Dean
81	North Coast Areas 3 to 6 – Odd &	PKE::Hecate Lowlands
-	Even	PKE::Hecate Strait-Fjords
		PKE::Middle-Upper Skeena
		PKE::Nass-Skeena Estuary
		PKE::Upper Nass
		PKO::Hecate Strait-Fjords
		PKO::Hecate Strait-Lowlands
		PKO::Lower Skeena
		PKO::Middle and Upper Skeena
		PKO::Nass-Portland-Observatory
		PKO::Nass-Skeena Estuary
		PKO::Upper Nass
82	Haida Gwaii – Odd & Even	PKE::East Haida Gwaii
-		PKE::North Haida Gwaii
		PKE::West Haida Gwaii
1		PKO::East Haida Gwaii
		PKO::North Haida Gwaii
		PKO::West Haida Gwaii
Chum	le p:	CM::Lower Fraser
83	Fraser River	CM::Northwest Vancouver Island
84	WCVI	CM::Southwest Vancouver Island
85	Johnstone Strait Area and Mainland	CM::Bute Inlet
0.5	Inlets (Areas 11 to 13)	CM::Loughborough
	imoto (i notae i i to i o)	CM::Northeast Vancouver Island
		CM::Southern Coastal Streams
		CM::Upper Knight
86	Georgia Strait	CM::Georgia Strait
		CM::Howe Sound-Burrard Inlet
87	Coastal Areas 5 & 6	CM::Douglas-Gardner
		CM::Hecate Lowlands
		CM::Mussel-Kynoch
88	Haida Gwaii	CM::East HG
		CM::North Haida Gwaii
		CM::North Haida Gwaii-Stanley Creek
		CM::Skidegate
		CM::West Haida Gwaii
89	Skeena – Nass	CM::Lower Nass
		CM::Lower Skeena
	7. 10	CM::Middle Skeena
90	Areas 7 to 10	CM::Bella Coola River-Late CM::Bella Coola-Dean Rivers
		ICIVIT BEHA COOIA-DEATI KIVETS
		CM::Rivers Inlet

OU No.	Outlook Unit Name	Conservation Unit
		CM::Wannock
91	Yukon (mainstem)	CM::Donjek-Kluane
		CM::Middle Yukon River
		CM::North Yukon River
		CM::Old Crow
		CM::Stewart
		CM::Teslin
		CM::White River
92	Yukon (Porcupine)	CM::Porcupine River
		CM::Old Crow
93	Taku	CM::Taku

Appendix 2. Definitions of acronyms used in this document.

Acronym	Expanded Form
CK	Chinook salmon
CM	Chum salmon
CO	Coho salmon
CSAS	Canadian Science Advisory Secretariat
CU	Conservation Unit
DD	Data Deficient (WSP Status classification)
EFS	Effective Female Spawners
ENSO	El Niño – Southern Oscillation
GST	Georgia Strait
IMEG	Interim Management Escapement Goal
MEF	Mid-Eye to Fork (length measurement)
MSY	Maximum Sustainable Yield
NA	Not Applicable
ND	No Data (i.e. data deficient)
NWVI	Northwest Vancouver Island
OU	Outlook Unit
PKE	Pink salmon – Even year (Conservation Unit type)
PKO	Pink salmon – Odd year (Conservation Unit type)
PST	Pacific Salmon Treaty
SEL	Sockeye salmon – Lake (Conservation Unit type)
SER	Sockeye salmon – River (Conservation Unit type)
SWVI	Southwest Vancouver Island
TTC	Trans-boundary Technical Committee
US	United States of America
WCVI	West Coast Vancouver Island

From: Russow, Theona
Sent: April-02-19 11:35 AM

To: Didluck, David; Lowe, Carmel; pac.prmc / pac.urpcm (DFO/MPO)

Cc: Dickie, Catherine; Rakkar, Jasmine

Subject: RE: **URGENT** Contact info required COB today: 2019-001-00564 'Namgis - re: Federal

Court ruling regarding DFO policy on PRV

Hi Heather,

Your best point of contact for this would be Allison Webb who is currently in Ottawa and is working on all things 'Namgis and is in the loop regarding the work to develop a decision-making framework and the timelines to consult with the 'Namgis to meet the court-imposed deadline. Carmel may want to weigh in with respect to the CSAS process.

Thanks, Theona

Theona Russow | Senior Advisor | Reconciliation & Partnerships | Fisheries & Oceans Canada | Pêches et Océans Canada | Pacific Regional Office | Région du Pacifique | 200- 401 Burrard Street | 401 rue Burrard, Pièce 200 | Vancouver, BC V6C 3S4 | Theona.Russow@dfo-mpo.gc.ca | Telephone | Téléphone (604) 666-0776 | Cell (Government of Canada | Gouvernement du Canada

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----- Original message -----

From: "pac.prmc / pac.urpcm (DFO/MPO)" < XPAC.PRMCU@dfo-mpo.gc.ca>

Date: 2019-04-02 10:36 AM (GMT-08:00)

To: "Lowe, Carmel" < <u>Carmel.Lowe@dfo-mpo.gc.ca</u>>, "Didluck, David" < <u>David.Didluck@dfo-mpo.gc.ca</u>> Cc: "Dickie, Catherine" < <u>Catherine.Dickie@dfo-mpo.gc.ca</u>>, "Rakkar, Jasmine" < <u>Jasmine.Rakkar@dfo-mpo.gc.ca</u>>

Subject: **URGENT** Contact info required COB today: 2019-001-00564 'Namgis - re: Federal Court ruling regarding DFO policy on PRV

Hi Carmel and David,

This urgent request came from MCCU this morning. Can you advise us who would be the contact person in PAC or if indeed it is even appropriate for someone to be making this contact given the current legal situation?

Thanks,

Heather

From: Maloney, Barbara <Barbara.Maloney@dfo-mpo.gc.ca>

Sent: April-02-19 10:12 AM

To: pac.prmc / pac.urpcm (DFO/MPO) < XPAC.PRMCU@dfo-mpo.gc.ca>

s.16(2)(c)

Cc: Jaremek, Daniel < Daniel. Jaremek@dfo-mpo.gc.ca>

Subject: Contact info required COB today: 2019-001-00564 'Namgis - re: Federal Court ruling regarding

DFO policy on PRV Importance: High

Hi PAC MCU.

We received a new incoming on this docket, including affidavits, transcripts and ATIP requests.

MCU recommends including the name of someone from Pacific Region who will contact Chief Svanvik. Could you please provide the necessary contact information as indicated in the attached draft reply, by end of day today?

We will then route it for	and send an info copy to Indigenous Affairs and
Reconciliation.	

Thanks very much for your help, Barb

Barbara Maloney

Writer/Editor, Ministerial Correspondence Unit Fisheries and Oceans Canada / Government of Canada barbara.maloney@dfo-mpo.gc.ca / Tel: 613-943-2470

Rédactrice-réviseure, Unité de la correspondance ministérielle Pêches et Océans Canada / Gouvernement du Canada barbara.maloney@dfo-mpo.gc.ca / Tél: 613-943-2470

XNCR-GrpCW/RC@dfo-mpo.gc.ca to contact all MCU Writers / pour rejoindre tous les rédacteurs d'UCM XNCR-GrpCA/AC@dfo-mpo.gc.ca to contact all MCU Analysts / pour rejoindre tous les analystes d'UCM

2019-001-00564

From:

Cc:

Minister / Ministre (DFO/MPO); Jonathan, Wilkinson@parl.gc.ca To:

Reid. Rebecca

Subject:

Correspondence from the "Namgis First Nation re Fisheries and Oceans" Policy not to test for PRV

Date:

March-04-19 2:57:51 PM

"Namgis March 4, 2019 Letter to Minister of Fisheries and Oceans.pdf Attachments:

Dear Minister Wilkinson,

Please find attached correspondence from 'Namgis First Nation regarding Fisheries and Oceans Canada's policy not to test for PRV.

Kind regards,

Lawyer

P: +

F: +1 (604) 682-7131

MLT Aikins LLP

Vancouver, British Columbia V6C 2G8

mitalkins.com

BIO YCARD

MLT Aikins



Winnipeg | Regina | Saskatoon | Calgary | Edmonton | Vancouver

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s.19(1)



March 4, 2019

By Email: Jonathan.Wilkinson@parl.gc.ca

Department of Fisheries and Oceans Canada Justice Building Suite 09 House of Commons Ottawa. ON K1A 0A6

Attention:

The Honourable Minister Jonathan Wilkinson

Minister of Fisheries, Oceans and the Canadian Coast Guard

Dear Minister Wilkinson:

Re: Fisheries and Oceans Canada's ("DFO") Reconsideration of its Policy not to test for the Piscine Orthoreovirus ("PRV") before authorizing introductions of fish into the Marine Environment (the "PRV Policy")

On February 4, 2019, the Federal Court quashed DFO's PRV Policy finding it unreasonable and unlawful on four independent grounds. The Federal Court ordered that the Minister of Fisheries, Oceans and the Canadian Coast Guard (the "Minister"), or his delegate, reconsider the continuation of the PRV Policy and take into account the Court's reasons when doing so.

The Court found that DFO had breached the Crown's duty to consult and accommodate 'Namgis with respect to the PRV Policy. 'Namgis remains deeply concerned that introductions of smolts infected with PRV into the marine environment may have an adverse impact on its constitutionally protected Aboriginal title and rights. 'Namgis once again reiterates its objection to the continuation of the PRV Policy and the need for DFO to consult and accommodate 'Namgis with respect to that Policy. We wish to begin that consultation as soon as possible.

In the interim, 'Namgis is reviewing the Federal Court's decision. Upon completion of that review, 'Namgis will provide the Minister with further information on how any continuation of the PRV Policy may adversely affect its constitutionally protected Aboriginal title and rights.

Sincerely, Jon Summit

'Namgis First Nation

Per: Chief Don Svanvik

cc. Rebecca Reid (*Rebecca.Reid@dfo-mpo.gc.ca*),
Regional Director General, Fisheries and Oceans Canada

From: Miller-Saunders, Kristi
Sent: April-02-19 2:19 PM

To: McLeod, Patricia; Lowe, Carmel; MacDougall, Lesley; Kennedy, Eddy; Houston, Kim; Candy,

John; Higgins, Mark

Subject: RE: ACTION: ATIP Due by 9 a.m. on Fri. 5-APR-19 - A-2018-01419 / CW RE: PRV JAN 2019

CSAS - see below for more details

I may not get to this.

Kristi

From: McLeod, Patricia Sent: April 2, 2019 12:46 PM

To: Lowe, Carmel; MacDougall, Lesley; Kennedy, Eddy; Houston, Kim; Candy, John; Higgins, Mark; Miller-Saunders, Kristi **Subject:** ACTION: ATIP Due by 9 a.m. on Fri. 5-APR-19 - A-2018-01419 / CW RE: PRV JAN 2019 CSAS - see below for more

details

Hi everyone,

Please review the details and directions contained in the ATIP request below. If you feel you will need an extension please let me know asap.

If you or your staff identify records, please provide them along with the <u>completed forms (SME Checklist(s) and Return memo – links below)</u> to Trish McLeod <u>patricia.mcleod@dfo-mpo.gc.ca</u> (Office number: C137 – down from the mailroom) for RDS approval by 9 a.m. on Friday, April 5. Apologies for the short turn-around.

- · If clarification is required, please respond to this email with a clarification request.
- If you have no records, please confirm with a <u>"NIL" response to me patricia.mcleod@dfo-mpo.gc.ca</u>
- · Please ensure that your documents are routed through your Division EA
- · If this request is likely to generate a large number of records, please advise as the due date would need to be adjusted to provide additional time for RD review.
- As always documents must be printed memo style / separated by a piece of coloured paper

Thanks everyone, Trish 250-756-7169

From: PacATIP/PacATI (DFO/MPO) < PacATIP-PacATI@dfo-mpo.gc.ca>

Sent: April-02-19 11:15 AM

To: Webb, Cheryl < Cheryl.Webb@dfo-mpo.gc.ca; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca; Thomson, Andrew < Andrew.Thomson@dfo-mpo.gc.ca; Girouard, Louise < Louise.Girouard@dfo-mpo.gc.ca; Girouard, Louise <a href="mailto:Louise.girouard@

Document Released Under the Access to Information Act / Document divulgué en vertu

Cc: Egglefield, Chien-Yung Lily < Chien-YungLily. Egglefield@dfo-mpo.gc.ca*; Barton, Meagan ation. < Meagan. Barton@dfo-mpo.gc.ca*; Dickie, Catherine < Catherine. Dickie@dfo-mpo.gc.ca*; Pringle, Sarah < Sarah. Pringle@dfo-mpo.gc.ca*; Owens, Heather < Heather. Owens@dfo-mpo.gc.ca*; Russow, Theona < Theona. Russow@dfo-mpo.gc.ca*; PacATIP/PacATI (DFO/MPO) < PacATIP-PacATI@dfo-mpo.gc.ca*

Subject: ATIP Request Due to RDGO April 8 // A-2018-01419 / CW

Request: "All communications, materials, meeting notes, briefings, summary regarding January 2019 CSAS on PRV including to and from Jay Parsons, Gilles Olivier, Ingrid Burgetz, Kristi Miller, Alistair Struthers from December 01, 2018 through March 28, 2019."

Response package due to RDGO ATIP desk (12 noon): <April 8. 2019>

After reviewing this request, please let me know if your branch will have records to submit.

To: Program Managers and Subject Matter Experts

Steps to responding to this ATIP request:

1. Review the wording of the request below. Is it clear? If not, inform your ATIP Contact immediately.

Access to Information Act request for:

- "All communications, materials, meeting notes, briefings, summary regarding January 2019 CSAS on PRV including to and from Jay Parsons, Gilles Olivier, Ingrid Burgetz, Kristi Miller, Alistair Struthers from December 01, 2018 through March 28, 2019."
- 2. Review the distribution list above. If you believe the request should be forwarded to a DFO office not listed, inform your ATIP Contact immediately.
- 3. If you have a large number of records (over 1000 pages) notify your ATIP Contact as there is a possibility of extending the time limit or narrowing the scope of the request. If you anticipate less than 1000 pages in response to the request, proceed to step 4.
- 4. Retrieve records. Use the SME Checklist to prepare records and recommendations. Records and recommendations are due to your ATIP Contact by: **Noon < April 8, 2019**>
- 5. Advise Communications and provide their office with relevant materials, if necessary.

Notes:

- (1) Program managers must be prepared to answer questions which might result from disclosure of the records.
- **it is strongly recommended a copy of the ATIP by the sector it produces be made to refer to once the ATIP has left the Region. The ATIP Co-ordinator in our region is not responsible for retaining or recalling a copy of the ATIP.
- (2) Electronic correspondence regarding the processing of this request must be encrypted if it contains PROTECTED B information. Please do not transmit information classified higher than Protected B via e-mail.
- (3) For more information on how to respond to ATIP requests, go to the ATIP Secretariat intranet site at: http://intra.ent.dfo-mpo.ca/atip.

Response packages MUST include:

- (1) all relevant records; single sided
- (2) completed SME Checklist(s) with recommendations that meet the standards set out in the SME Checklist;
- (3) completed Return Memo signed by the appropriate official.

*Please ensure you are using the most current version of the Return Memo and the SME checklist which can be found on the ATIP intranet page at the following links:

Return Memo: https://intra.ent.dfo-mpo.ca/atip/forms/ReturnMemo SME Checklist: https://intra.ent.dfo-mpo.ca/atip/forms/SMEchecklist Attachment link: (1) SME Checklist; (2) Return Memo

Thank you,

Ashley Church A/ Pacific Region ATIP Coordinator Coordonnateur de l'AIPRP pour la region du Pacifique (604) 775-7830 telephone/de téléphone

From: Lévesque, Marie-Pier < Marie-Pier.Levesque@justice.gc.ca>

Sent: April-04-19 8:41 AM

To: Burgetz, Ingrid; Webb, Allison; Parsons, Jay

Cc: Dostal, Alexandra; Ikejiani, Alexander (DOJ); House, Matthew (DOJ); Haesevoets, Roderick;

Lowe, Carmel

Subject:

Attachments:

Importance: High

Ingrid, Allisson, Jay,

Marie-Pier Lévesque

Acting Senior Counsel, Fisheries and Aquaculture Management
Department of Fisheries and Oceans Legal Services
200 Kent St., 8th Floor, Ottawa (Ontario) K1A 0E6
Department of Justice Canada / Government of Canada
marie-pier.levesque@justice.gc.ca / Tel: 613-998-4781 / Fax 613-990-9385

Avocate-conseil intérimaire, gestion des pêches et de l'aquaculture Services juridiques du Ministère des Pêches et des Océans 200 rue Kent, 8e étage, Ottawa (Ontario) K1A 0E6 Ministère de la Justice Canada / Gouvernement du Canada marie-pier.levesque@justice.gc.ca / Tél: 613-998-4781 / Fax 613-990-9385

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From: House, Matthew

Sent: Wednesday, April 03, 2019 5:23 PM

To: Ikejiani, Alexander < Alexander. Ikejiani@justice.gc.ca>; Lévesque, Marie-Pier < Marie-

Pier.Levesque@justice.gc.ca>

Cc: Sharzer, Stephen <Stephen.Sharzer@justice.gc.ca>; Beaton, Heather

<Heather.Beaton@justice.gc.ca>

Subject:

Importance: High

s.23

Sent from my BlackBerry 10 smartphone on the Bell network.

From: MacIsaac, Gwen < Gwen.MacIsaac@justice.gc.ca > Sent: Wednesday, April 3, 2019 5:56 PM
To: House, Matthew
Subject: |

Hello Matt,

Gwen

Pages 353 to / à 357 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

From:

Webb, Allison

Sent:

April-07-19 11:43 AM

To:

MacDougall, Lesley; Lowe, Carmel; Thomson, Andrew

Subject:

FW: Media on PRV

FYI only

 $\frac{https://www.thestar.com/vancouver/2019/04/06/is-this-the-cod-collapse-all-over-again-bc-scientists-and-first-nation-fight-dfo-to-save-salmon.html}{}$

From:

McLeod, Patricia

Sent:

April-10-19 1:56 PM

To:

MacDougall, Lesley; Prince, Dave; Houston, Kim; Kennedy, Eddy; Holmes, John; Lowe,

Carme

Subject:

ATIP due to RDS by 9 a.m. on Tues. 16-April-2019 // A-2019-00041 / JD (PRV / POLINSKI /

SCIENTIFIC PAPER)

Importance:

High

Hi everyone,

An ATIP request has been received. Please see below for further information.

Please canvas your people for documents pertaining to this request and provide said documents to the RDS office by 9 a.m. on Tuesday, April 16.

This will allow a small window of opportunity for review before the deadline to the Regional Director General (noon on Thursday, April 18).

A NIL response is required to patricia.mcleod@dfo-mpo.gc.ca

If you require clarification - please contact the Acting ATIP Advisor below.

Thanks, Trish McLeod Executive Assistant 250-756-7169

From: PacATIP/PacATI (DFO/MPO) <PacATIP-PacATI@dfo-mpo.gc.ca>

Sent: Wednesday, April 10, 2019 1:38 PM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Cc: Dickie, Catherine <Catherine.Dickie@dfo-mpo.gc.ca>; Egglefield, Chien-Yung Lily <Chien-YungLily.Egglefield@dfo-mpo.gc.ca>; Girouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>; Owens, Heather <Heather.Owens@dfo-mpo.gc.ca>; Russow, Theona <Theona.Russow@dfo-mpo.gc.ca>; PacATIP/PacATI (DFO/MPO) <PacATIP-PacATI@dfo-mpo.gc.ca>; McLeod, Patricia

<Patricia.McLeod@dfo-mpo.gc.ca>

Subject: ATIP Request Due to RDGO April 18, 2019 // A-2019-00041 / JD

Good afternoon,

Please find a new incoming ATIP request below.

If you have any questions or if you think another group should be tasked, please don't hesitate to let me know.

Document Released Under the Access to Information Act / Document divulgué en vertu de la Loi sur l'accès à l'information.

Response package due to RDGO ATIP desk (12 noon): < April 18, 2019>

After reviewing this request, please let me know if your branch will have records to submit.

To: Program Managers and Subject Matter Experts

Steps to responding to this ATIP request:

1. Review the wording of the request below. Is it clear? If not, inform your ATIP Contact immediately.

Access to Information Act request for:

FAll correspondence between the dates of March 10, 2019 and April 10 2019 with Mark Polinski, DFO on the subject of his PRV research project, that resulted in the scientific paper that was published in the journal Frontiers in Physiology in March 2019.

- 2. Review the distribution list above. If you believe the request should be forwarded to a DFO office not listed, inform your ATIP Contact immediately.
- 3. If you have a large number of records (over 1000 pages) notify your ATIP Contact as there is a possibility of extending the time limit or narrowing the scope of the request. If you anticipate less than 1000 pages in response to the request, proceed to step 4.
- 4. Retrieve records. Use the SME Checklist to prepare records and recommendations. Records and recommendations are due to your ATIP Contact by: Noon < April 18, 2019>
- 5. Advise Communications and provide their office with relevant materials, if necessary.

Notes:

- (1) Program managers must be prepared to answer questions which might result from disclosure of the records. . . **it is strongly recommended a copy of the ATIP by the sector it produces be made to refer to once the ATIP has left the Region. The ATIP Co-ordinator in our region is not responsible for retaining or recalling a copy of the ATIP.
- (2) Electronic correspondence regarding the processing of this request must be encrypted if it contains PROTECTED B information. Please do not transmit information classified higher than Protected B via email.
- (3) For more information on how to respond to ATIP requests, go to the ATIP Secretariat intranet site at: http://intra.ent.dfo-mpo.ca/atip.

Response packages MUST include:

- (1) all relevant records; single sided
- (2) completed SME Checklist(s) with recommendations that meet the standards set out in the SME Checklist;
- (3) completed Return Memo signed by the appropriate official.

*Please ensure you are using the most current version of the Return Memo and the SME checklist which can be found on the ATIP intranet page at the following links:

Return Memo: https://intra.ent.dfo-mpo.ca/atip/forms/ReturnMemo SME Checklist: https://intra.ent.dfo-mpo.ca/atip/forms/SMEchecklist

Attachment link: (1) SME Checklist; (2) Return Memo

Best regards,

Ryan Fisher A/ Pacific Region ATIP Coordinator Coordonnateur de l'AIPRP pour la region du Pacifique (604) 775-7830 telephone/de téléphone

From: Krahn, Danielle
Sent: April-17-19 6:24 AM

To: House, Matthew (DOJ); Moore, Wayne; Parsons, Jay; Webb, Allison; Campbell, John P.;

Quinn, Caroline; Martell, D John; Thomson, Andrew; Patirana, Anoma; Haesevoets, Roderick;

Khatkar, Sunita; MacDougall, Lesley; Payne, Brigid

Cc: Ikejiani, Alexander (DOJ); Levesque, Marie-Pier (DOJ); Burgetz, Ingrid; Jenkins, Phil; Lowe,

Carmel; Pilcher, Scott; Salomi, Corino; Fagan, Ashley; Medeiros, Dean; Levesque, Marie-Pier

(DOJ); McCorquodale, Brenda

Subject: PRV Task Team Meeting - Updated Products

Hello Everyone.

In light of today's cancelled task team meeting, if anyone feels that a quick meeting would be beneficial, please let me know by noon today and I will reschedule for tomorrow.

Otherwise, in order to prepare for the ADM Working Group and meeting with Kevin Stringer tomorrow, please provide me with any necessary updates or revised products by **COB today**.

Many thanks, Danielle

Danielle Krahn

Analyst / Analyste
Fisheries and Oceans Canada / Ministère des Pêches et Océans
Aquaculture Management / La gestion de l'aquaculture
200 Kent Street / 200, rue Kent
Ottawa, Ontario K1A 0E6
Telephone / Téléphone:

s.16(2)(c)

From:

Rainer, Michelle

Sent:

April-25-19 4:00 PM

To:

Lowe, Carmel

Cc:

Dickie. Catherine

Subject:

For approval: Fact sheet on PRV

Attachments:

FS_AQUA_PRV_draft.docx

Hi Carmel.

Please find attached for your approval a fact sheet on PRV and HSMI in BC. We would like to include this in a media package for the department's upcoming response to the Namgis/Morton case (in June; NHQ is preparing the media lines and other material but I don't have any drafts to share yet). Mark Polinski has been a huge help in making this topic more clear for the general public. Henrik Kreiberg approved on Leslie's behalf.

Thanks,

Michelle

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FACT SHEET

Many members of the public have questions about piscine orthoreovirus (PRV) and heart and skeletal muscle inflammation (HSMI). They have heard that PRV and HSMI are a threat to wild salmon and are understandably concerned. This fact sheet provides current information on the international scientific community's understanding of PRV and HSMI, and how Fisheries and Oceans Canada (DFO) is acting to protect our salmon resources.

What are PRV and HSMI?

It is important to understand that the terms 'virus' (an organism) and 'disease' (an abnormal condition) are not interchangeable. Sometimes viruses cause disease, other times they do not.

Piscine orthoreovirus (PRV) is a virus that occurs naturally in oceans around the world. Salmon and trout are the normal host of PRV. In Canada, PRV is commonly found in multiple salmon and trout species, both wild and farmed.

Heart and skeletal muscle inflammation (HSMI) is a disease of farmed Atlantic salmon that is caused by PRV. HSMI can make farmed fish swim slowly and sometimes die, particularly under other stressful circumstances. To date, HSMI has not been found in any wild salmon, and not all farmed Atlantic salmon that have PRV develop HSMI. Nevertheless, some experts have voiced concern that, because PRV can cause HSMI in farmed Atlantic salmon, PRV may also be able to cause HSMI or a similar disease in species of wild salmon such as coho, chinook, or sockeye that live in BC's waters.

Do all PRV infections cause disease?

Many salmon which become infected with PRV, particularly in Canada, do not become diseased and are not adversely affected by the virus' presence. This is one reason why there is so much debate about PRV's ability to cause disease like HSMI in BC salmon. It also means that screening a salmon to see if it has PRV does not tell us whether that fish is (or will become) sick.

Can PRV cause disease equally in all salmon and trout?

For reasons we don't yet understand, PRV affects salmon differently depending on the location and species involved.

There can be striking differences in the affect PRV has on farmed Atlantic salmon in different regions of the world. This is evident by comparing PRV and HSMI in BC and Norway.

Norway	BC

s.21(1)(a)

s.21(1)(b)

Both PRV and HSMI are common in farmed Atlantic salmon	PRV is common in farmed Atlantic salmon but disease suggestive of HSMI is rare.
Fish swim abnormally and lose weight when affected by HSMI; the disease seriously impacts farm production	Fish swim normally and eat well when HSMI or similar disease has occurred; the impact to farm production is negligible
PRV has repeatedly caused heart inflammation typical of HSMI in laboratory studies	PRV has repeatedly failed to cause HSMI-like heart inflammation in laboratory studies
There are two types of PRV:PRV-1 and PRV-3. Both virus types can infect Atlantic salmon and rainbow trout; however, only PRV-1 causes disease in Atlantic salmon and only PRV-3 causes disease in Rainbow trout	There is only one type of PRV (PRV-1). This PRV can infect all five species of migratory Pacific salmon; however, studies with Sockeye salmon indicate that they are less susceptible to PRV than Atlantic salmon. Studies with other Pacific salmon are ongoing.

Why is there scientific debate about HSMI in British Columbia?

Laboratory studies in BC have identified that PRV does not cause severe heart inflammation in Atlantic salmon like it does in Norway, yet at least two cases of heart inflammation very similar to what has been diagnosed as HSMI in Norway have been observed on Atlantic salmon farms in BC. Was this HSMI caused by PRV? Some scientists have suggested that enough evidence is available to conclude that these instances were indeed HSMI caused by PRV; other scientists find the evidence insufficient to suggest PRV had a causative role and that these isolated occurrences could have been caused by other factors. This debate is important because defining whether or not PRV can cause disease in farmed salmon populations is a cornerstone for the concern of a similar disease occurring in wild stocks.

It's important to remember that scientists, clinicians and pathologists don't always agree. This debate is healthy and a normal part of the scientific process.

Current research

DFO has multiple research projects underway to improve our understanding of PRV, its potential for transmission between wild and farmed salmon, and its ability to cause disease in both Atlantic and Pacific salmon. The outcomes will inform DFO's management strategies.

A summary of recent research worldwide can be found at: www.dfo-mpo.gc.ca/science/aah-saa/species-especes/aq-health-sante/prv-rp-eng.html.

For a compendium of the aquaculture research and development projects from all across Canada on fish health, including several on PRV, visit: www.dfo-mpo.gc.ca/aquaculture/sci-res/rd-eng.htm.

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Does DFO test farmed fish for PRV or HSMI?

In BC, DFO has regulations and programs in place to minimize the risk of disease, parasites and pathogens to farmed fish and the chance that these could transfer to wild species. Since PRV occurs naturally in BC, is commonly present in our coastal waters, and is detected in healthy fish, its presence is not an indication of disease. Given these factors DFO does not conduct routine testing for PRV.

DFO does track the incidence of HSMI on BC salmon farms. HSMI is a diagnosis based on microscopic examination of the heart and other tissues. This diagnostic method is applied to every fish sampled by DFO auditors and would identify any fish affected with HSMI or heart disease of other causes.

HSMI is not among the <u>diseases regulated by the Canadian Food Inspection Agency (CFIA)</u>, which regulates aquatic animal diseases that could seriously impact aquatic animal health, the Canadian economy and international trade.

To learn more and to read public reports on the health of farmed fish in BC, visit: www.dfo-mpo.gc.ca/aquaculture/protect-protege/reduce-disease-reduire-maladie-eng.html

More information on PRV and HSMI can be found at: www.dfo-mpo.gc.ca/science/aah-saa/species-especes/aq-health-sante/prv-rp-eng.html.

From:

Kreiberg, Henrik

Sent:

April-26-19 7:42 AM

To:

McCorquodale, Brenda; Parsons, Jay

Cc:

Lowe, Carmel

Subject:

RE: Follow up from PRV call today

Hi Brenda – referred this to Mark Higgins who is providing Sci. Br. continuity on the PRV file; will follow up with him this morning.

Thanks/HK

Henrik Kreiberg

Head, Applied Technologies Section, Aquatic Diagnostics, Genomics & Technologies Division Dept. of Fisheries & Oceans, Government of Canada Pacific Biological Station, Nanaimo BC Canada V9T 6N7
Tel 250-756-7019 (fax 7053) henrik.kreiberg@dfo-mpo.gc.ca

Chef de section, Technologies appliquées,
Division des diagnostics aquatiques, génomique et technologies,
Pêches et Océans Canada / Gouvernement du Canada
Station biologique du Pacifique, Nanaimo CB Canada V9T 6N7
Tel 250-756-7019 henrik.kreiberg@dfo-mpo.gc.ca

From: McCorquodale, Brenda <Brenda.McCorquodale@dfo-mpo.gc.ca>

Sent: 2019-April-25 4:09 PM

To: Kreiberg, Henrik <Henrik.Kreiberg@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Cc: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Subject: Follow up from PRV call today

Hi Henrik and Jav

Just a note to follow up on the PRV call earlier today that Wayne Moore was on. I was tasked with contacting you to see where the paper on aggregates of salmonid stocks is (for incorporation with the practitioners' guide) and what the eta is for a draft of the Disease Agent Support Tool.

Thanks Brenda

Brenda McCorquodale

A/ Director, Aquaculture Management (April 18 – May 15, 2019) Regional Manager, Aquaculture Resource Management Fisheries and Oceans Canada Gestionnaire régionale des ressources, Direction des peches Pêches et Océans Canada

1965 Island Diesel Way |Nanaimo, BC | Nanaimo, CB |V9S 5W8 Email | Courriel: Brenda.McCorquodale@dfo-mpo.gc.ca

Telephone I Téléphone: 250-754-0367

From: Sent: Rainer, Michelle April-26-19 3:54 PM

To: Cc: Lowe, Carmel Dickie, Catherine

Subject:

revisions to PRV fact sheet

Attachments:

FS_AQUA_PRV_draft.docx

Hi Carmel,

Mark and I made some revisions for your review.

Thanks, Michelle

Document Released Under the Access to Information Act / Document divulgué en vertu de la Loi sur l'accès à l'information.

FACT SHEET (

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disease in Rainbow trout	Atlantic salmon and do not become diseased. Studies with other Pacific salmon are ongoing.

Commented [LC1]: This is unclear - need to clarify if sockeye are less susceptible to infection by PRV-1 or to becoming diseased when they are infected with PRV-1.

Commented [RM2]: Mark added clarification

Why is there scientific debate about HSMI in British Columbia?

Laboratory studies in BC have identified that PRV does not cause severe heart inflammation in Atlantic salmon like it does in Norway, yet at least two cases of heart inflammation very similar to what has been diagnosed as HSMI in Norway have been observed on Atlantic salmon farms in BC. Was this HSMI caused by PRV? Some scientists have suggested that enough evidence is available to conclude that these instances were indeed HSMI caused by PRV; other scientists find the evidence insufficient to suggest PRV had a causative role and that these isolated occurrences could have been caused by other factors. This debate is important because defining whether or not PRV can cause disease in farmed salmon populations is a cornerstone for the concern of a similar disease occurring in wild stocks. This debate is important because if PRV can cause disease in farmed salmon populations, that would indicate a concern for wild stocks.

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Commented [LC3]: 'defining' seems an inappropriate choice of wording here – consider replacing with 'evidence of'

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Commented [LC4]: This is unclear and needs rephrasing.

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Commented [RM5]: Does this work?

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Document Released Under the Access to Information Act / Document divulgué en vertu de la Loi sur l'accès à l'information.

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Document Released Under the Access to Information Act / Document divulgué en vertu de la Loi sur l'accès à l'information.

Dickie, Catherine

House, Matthew < Matthew. House@justice.gc.ca> From:

May-10-19 8:55 AM Sent:

Haesevoets, Roderick; Morel, Philippe; Reid, Rebecca; Lowe, Carmel; Moore, Wayne; To:

Thomson, Andrew; Girouard, Louise; Quinn, Caroline; McCorquodale, Brenda; Campbell, John P.; McPherson, Arran; Sharzer, Stephen (DOJ); Struthers, Alistair; Dostal, Alexandra Levesque, Marie-Pier (DOJ); Krahn, Danielle; Parsons, Jay; Burgetz, Ingrid; Jenkins, Phil;

Fagan, Ashley; Medeiros, Dean; Rainer, Michelle; Laframboise, Leslie (DOJ); Paylor, Adrienne;

Seguin, Natalie; Merritt, Olivia

Subject:

Cc:

High Importance:

Roderick,

Matt

From: Haesevoets, Roderick [mailto:Roderick.Haesevoets@dfo-mpo.gc.ca]

Sent: Friday, May 10, 2019 11:48 AM

To: Morel, Philippe <Philippe.Morel@dfo-mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca>; Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca>; Girouard, Louise < Louise. Girouard@dfo-

mpo.gc.ca>; Quinn, Caroline <Caroline.Quinn@dfo-mpo.gc.ca>; McCorquodale, Brenda

<Brenda.McCorquodale@dfo-mpo.gc.ca>; Campbell, John P. <John.Campbell@dfo-mpo.gc.ca>;

McPherson, Arran < Arran. McPherson@dfo-mpo.gc.ca>; Sharzer, Stephen

<Stephen.Sharzer@justice.gc.ca>; Struthers, Alistair <Alistair.Struthers@dfo-mpo.gc.ca>; Dostal,

Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca>

Cc: Lévesque, Marie-Pier < Marie-Pier. Levesque@justice.gc.ca>; Krahn, Danielle < Danielle. Krahn@dfompo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Burgetz, Ingrid <Ingrid.Burgetz@dfompo.gc.ca>; Jenkins, Phil < Phil.Jenkins@dfo-mpo.gc.ca>; Fagan, Ashley < Ashley.Fagan@dfompo.gc.ca>; Medeiros, Dean < Dean. Medeiros@dfo-mpo.gc.ca>; Rainer, Michelle < Michelle.Rainer@dfo-

mpo.gc.ca>; Laframboise, Leslie <Leslie.Laframboise@justice.gc.ca>; House, Matthew

<Matthew.House@justice.gc.ca>; Paylor, Adrienne <Adrienne.Paylor@dfo-mpo.gc.ca>; Seguin, Natalie <Natalie.Seguin@dfo-mpo.gc.ca>; Merritt, Olivia <Olivia.Merritt@dfo-mpo.gc.ca>

Subject:

Importance: High

Hi all,

Cheers, Roderick.

s.21(1)(a)

s.21(1)(b)

s.23

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Roderick Haesevoets

A/Manager | Gestionnaire par interim Aquaculture Management Directorate | Direction de la gestion de l'aquaculture Fisheries and Oceans Canada | Pêches et Océans Canada 200 rue Kent St, STN 10E207

e-mail/courriel: roderick.haesevoets@dfo-mpo.gc.ca

tel: 1.613.301.3208

http://www.dfo-mpo.gc.ca/aquaculture/aquaculture-eng.html

No information has been removed or severed from this page

From:

Dostal, Alexandra

Sent:

May-24-19 1:41 PM

To:

House, Matthew (DOJ); Webb, Allison; McPherson, Arran; Parsons, Jay; Moore, Wayne; Lowe, Carmel; Haesevoets, Roderick; Campbell, John P.; Struthers, Alistair; Green, Barry;

Krahn, Danielle; Hubley, Marian; Sharzer, Stephen (DOJ); Struthers, Alistair; Quinn, Caroline

Cc:

Saumur-Kelly, Maude

Subject:

Alix Dostal

613-993-1884

From: House, Matthew < Matthew. House@justice.gc.ca>

Sent: Friday, May 24, 2019 4:14 PM

To: Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>; McPherson, Arran <Arran.McPherson@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Moore, Wayne <Wayne.Moore@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>; Haesevoets, Roderick <Roderick.Haesevoets@dfo-mpo.gc.ca>; Campbell, John P. <John.Campbell@dfo-mpo.gc.ca>; Struthers, Alistair <Alistair.Struthers@dfo-mpo.gc.ca>; Green, Barry <Barry.Green@dfo-mpo.gc.ca>; Krahn, Danielle <Danielle.Krahn@dfo-mpo.gc.ca>; Hubley, Marian <Marian.Hubley@dfo-mpo.gc.ca>; Sharzer, Stephen (DOJ) <stephen.sharzer@justice.gc.ca>; Struthers, Alistair <Alistair.Struthers@dfo-mpo.gc.ca>; Quinn, Caroline <Caroline.Quinn@dfo-mpo.gc.ca> Cc: Saumur-Kelly, Maude <Maude.Saumur-Kelly@dfo-mpo.gc.ca>

Subject:

Importance: High

Allison,

Matt

s.23

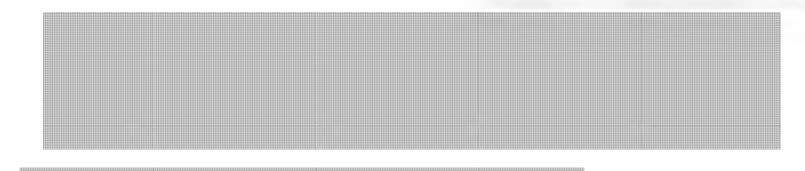
From: Webb, Allison [mailto:Allison.Webb@dfo-mpo.gc.ca]

Sent: Friday, May 24, 2019 2:50 PM

To: Dostal, Alexandra Alexandra.Dostal@dfo-mpo.gc.ca; McPherson, Arran Arran.McPherson@dfo-mpo.gc.ca; Moore, Wayne Wayne.Moore@dfo-mpo.gc.ca; Moore, Wayne.Moore@dfo-mpo.gc.ca; Haesevoets, Roderick
Roderick.Haesevoets@dfo-mpo.gc.ca; Campbell, John P. John.Campbell@dfo-mpo.gc.ca; Struthers, Alistair Alistair.Struthers@dfo-mpo.gc.ca; Green, Barry Barry.Green@dfo-mpo.gc.ca; Krahn, Danielle Danielle.Krahn@dfo-mpo.gc.ca; Hubley, Marian Matthew.House@justice.gc.ca; Struthers, Alistair Alistair.Struthers@dfo-mpo.gc.ca; Quinn, Caroline Caroline.Quinn@dfo-mpo.gc.ca; Quinn, Caroline Caroline.Quinn@dfo-mpo.gc.ca;

mpo.gc.ca> Cc: Saumur-Kelly, Maude < Maude.Saumur-Kelly@dfo-mpo.gc.ca> Subject:	
Thanks, Allison	
Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture Fisheries Management Branch / Direction de la gestion des pêches Fisheries and Oceans Canada / Pêches et Océans Canada 200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada 604-666-7009 Allison.webb@dfo-mpo.gc.ca	s.21(1 s.21(1 s.23
From: Dostal, Alexandra Alexandra.Dostal@dfo-mpo.gc.ca > Sent: Friday, May 24, 2019 11:46 AM To: McPherson, Arran Arran.McPherson@dfo-mpo.gc.ca ; Parsons, Jay Jay.Parsons@dfo-mpo.gc.ca ; Parsons, Jay Jay.Parsons@dfo-mpo.gc.ca ; Parsons, Jay Jay.Parsons@dfo-mpo.gc.ca ; Webb, Allison Allison.Webb@dfo-mpo.gc.ca ; Webb, Allison Allison.Webb@dfo-mpo.gc.ca ; Haesevoets, Roderick Roderick Roderick.Haesevoets@dfo-mpo.gc.ca	

s.21(1)(a) s.21(1)(b) s.23



Alix

Alix Dostal

613-993-1884

From: Dostal, Alexandra

Sent: Friday, May 24, 2019 9:15 AM

To: McPherson, Arran < Arran.McPherson@dfo-mpo.gc.ca>; Parsons, Jay < Jay.Parsons@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; Webb, Allison.Webb.gc.ca>; Webb, Allison.Webb.gc.ca>; Webb, Allison.Webb.gc.ca>; Webb.gc.ca>; Web

mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Haesevoets, Roderick

< Roderick. Haesevoets@dfo-mpo.gc.ca>; Campbell, John P. < John. Campbell@dfo-mpo.gc.ca>;

Struthers, Alistair < <u>Alistair.Struthers@dfo-mpo.gc.ca</u>>; Green, Barry < <u>Barry.Green@dfo-mpo.gc.ca</u>>; Krahn, Danielle < <u>Danielle.Krahn@dfo-mpo.gc.ca</u>>; Hubley, Marian < <u>Marian.Hubley@dfo-mpo.gc.ca</u>>;

Sharzer, Stephen (DOJ) < stephen.sharzer@justice.gc.ca >; House, Matthew (DOJ)

<<u>Matthew.House@justice.gc.ca</u>>; Struthers, Alistair <<u>Alistair.Struthers@dfo-mpo.gc.ca</u>>; Quinn,

Caroline < Caroline.Quinn@dfo-mpo.gc.ca>

Cc: Dostal, Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca >

Subject:

Colleagues,

Alix

s.21(1)(a)

Alix Dostal s.21(1)(b)

s.23

613-993-1884

From: Dostal, Alexandra

Sent: Friday, May 24, 2019 8:09 AM

To: McPherson, Arran < Arran.McPherson@dfo-mpo.gc.ca>; Parsons, Jay < Jay.Parsons@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; Webb, Allison.Webb.gc.ca>; Webb, Allison.Webb.gc.ca>; Webb, Allison.Webb.gc.ca>; Webb.gc.ca>; Webb, Allison.Webb.gc.ca>; Webb.gc.ca>; Webb

mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Haesevoets, Roderick

<Roderick.Haesevoets@dfo-mpo.gc.ca>; Campbell, John P. <John.Campbell@dfo-mpo.gc.ca>;

Struthers, Alistair <<u>Alistair.Struthers@dfo-mpo.gc.ca</u>>; Green, Barry <<u>Barry.Green@dfo-mpo.gc.ca</u>>; Krahn, Danielle <Danielle.Krahn@dfo-mpo.gc.ca>; Hubley, Marian <Marian.Hubley@dfo-mpo.gc.ca>;

Sharzer, Stephen (DOJ) <<u>stephen.sharzer@justice.gc.ca</u>>; House, Matthew (DOJ) <<u>Matthew.House@justice.gc.ca</u>>; Struthers, Alistair <<u>Alistair.Struthers@dfo-mpo.gc.ca</u>>; Quinn, Caroline <<u>Caroline.Quinn@dfo-mpo.gc.ca</u>>
Subject:

Hello colleagues,

Look forward to chatting with you soon - please feel free to reach out if anything here is unclear or if I have something wrong!

Cheers,

s.21(1)(a)

Alix

s.21(1)(b)

s.23

Alix Dostal

Director General, Aquaculture Management Directorate | Directrice générale, Direction de la gestion de l'aquaculture

Aquaculture Management Directorate | Direction de la gestion de l'aquaculture

Telephone | Téléphone: 613-993-1884

Alexandra.Dostal@dfo-mpo.gc.ca

Government of Canada | Gouvernement du Canada

From:

Lowe, Carmel

Sent:

May-24-19 9:01 AM

To:

McPherson, Arran

Subject:

Fwd: CSAS - PRV

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "McPherson, Arran" < Arran.McPherson@dfo-mpo.gc.ca>

Date: 2019-05-24 8:58 AM (GMT-08:00)

To: "MacDougall, Lesley" <Lesley.MacDougall@dfo-mpo.gc.ca>, "Reid, Rebecca" <Rebecca.Reid@dfo-mpo.gc.ca>, "Webb, Allison" <Allison.Webb@dfo-mpo.gc.ca>, "Lowe, Carmel" <Carmel.Lowe@dfo-

mpo.gc.ca>, "Dostal, Alexandra" < Alexandra. Dostal@dfo-mpo.gc.ca>, "Mcgrath, Cheryl" < Cheryl. Mcgrath@dfo-mpo.gc.ca>, "Mcgrath, Cheryl" < Cheryl < Chery

mpo.gc.ca>, "Quinn, Caroline" < Caroline.Quinn@dfo-mpo.gc.ca>, "Sharzer, Stephen (DOJ)"

<stephen.sharzer@justice.gc.ca>, "House, Matthew (DOJ)" <Matthew.House@justice.gc.ca>, "Robinson, Connor"

<Connor.Robinson@dfo-mpo.gc.ca>, "Campbell, John P." <John.Campbell@dfo-mpo.gc.ca>, "Hill, Johanna"

<Johanna.Hill@dfo-mpo.gc.ca>, "Stringer, Kevin" <Kevin.Stringer@dfo-mpo.gc.ca>, "Proctor, Jody"

<Jody.Proctor@dfo-mpo.gc.ca>, "Sargent, Timothy" <Timothy.Sargent@dfo-mpo.gc.ca>

Cc: "Parsons, Jay" < Jay. Parsons@dfo-mpo.gc.ca>

Subject: CSAS - PRV

Hi everyone, I can now confirm that the PRV CSAS is live. Jay will be sending a quick note to participants to let them know it has gone up. Arran.

From:	Webb, Allison	
Sent:	May-24-19 9:53 AM	
To:	McPherson, Arran; Lowe, Carmel	
Cc:	Dostal, Alexandra	
Subject:	RE: PRV documents - Please print for the Deputy	
	Rebecca yesterday. She was interested in ensurion de documents in particular. I can do another signal	
Thanks, Allison		
Allison Webb, Director / Direc	trice	
Aquaculture Management / Ge		
Fisheries management Branch Fisheries and Oceans Canada /	/ Direction de la gestion des pêches / Pêches et Océans Canada	
	irrard, Vancouver BC / C.B. V6C 3S4 Canada	
604-666-7009		
Allison.webb@dfo-mpo.gc.ca		
	Arran.McPherson@dfo-mpo.gc.ca>	《 Marchelle) Marchelle (Marchelle Marchelle) Marchelle (Marchelle) (Marchelle) (Marchelle) (Marchelle) (Marchelle)
	. 5.36 AM I.Lowe@dfo-mpo.gc.ca>; Webb, Allison <allison.w< th=""><th>/ebb@dfo-mpo.gc.ca></th></allison.w<>	/ebb@dfo-mpo.gc.ca>
	exandra.Dostal@dfo-mpo.gc.ca>	
Subject: FW: PRV document	nts - Please print for the Deputy	
Importance: High		
Hi, these are the current vehave you been talking to he		t weighed on these. Allison,
A COMPANY OF CARDON DOCUMENTATION OF THE COMPANY OF	Company of the Compan	na usan dan usanggan na usan dan usan usan usan sa kata usan na kata usan kata usan kata usan kata usan kata u
From: Robinson, Connor		
Sent: Friday, May 24, 2019		
	tte.Butler@dfo-mpo.gc.ca>; Proctor, Jody < <u>Jody.P</u>	
	<u>ongtin@dfo-mpo.gc.ca</u> >; Cousineau, Cécile < <u>Cecil</u> nine < <u>Jasmine.Jarjour@dfo-mpo.gc.ca</u> >; M cPherso	
	po.gc.ca>; Dostal, Alexandra < <u>Alexandra.Dostal@</u>	
Jay < <u>Jay.Parsons@dfo-mp</u>	<u>o.gc.ca</u> >; Sharzer, Stephen (DOJ) < <u>stephen.sharz</u>	
	inger@dfo-mpo.gc.ca>; House, Matthew (DOJ)	
	g <u>c.ca</u> >; Perry, Jacqueline < <u>Jacqueline.Perry@dfo</u> Please print for the Deputy	<u>-mpo.gc.ca</u> >
Importance: High	riodo printion and Dopaty	
Amendallada		
Annette/Jody, Here are the undated docu	ıments on PRV that we would propose to share wit	h the Minister for his
weekend reading.	minerate out 1/4 minerate and an alichose to stidig Air	
		s.19(1)
 1-pager (for Minister 	r)	s.21(1)(a)
		s.21(1)(b)
		s.23

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Annette, could you print these for the Deputy? Jody, we'll also add these to his weekend reading package here in Ottawa.

Please let us know if he has any concerns with sharing any of these with the Minister's office later this afternoon.

Thanks, Connor

Connor RobinsonAdvisor to the Associate Deputy Minister 613-990-0020

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Proposed Additional PRV Research

One important concern that has been raised is around how to assess any potential future changes in the pathogenicity or virulence of PRV and any associated changes in the responses of Pacific salmon.

Additional new research addressing these questions will allow DFO to continue to be vigilant about future risks to Pacific salmon.

DFO could announce / undertake a research study to track PRV and other microbes of known to be or potential pathogens in wild and farmed fish over time in order to examine if there are any changes in the prevalence or pathogenicity or virulence of these microbes, examine any potential changes in the trends in relation to changing environment conditions, such as temperature and other climate change-related parameters, and if any changes in the trends, assess if there are any associated changes in the responses of or impacts on Pacific salmon. In part, such a study could be undertaken using high-throughput technologies that will allow for rapid analysis of a high number of samples.

The department will continue its own current, ongoing scientific research on PRV. It will also rely on domestic and international experts in this field, and the peer review process, to apply the best science available when making management decisions for Canada's aquaculture sector. Incorporating new research findings in an on-going way is a key component in enabling aquaculture managers to consider additional interventions that can be rapidly applied should any unanticipated environmental or ecosystem change be detected.

Pages 382 to / à 402 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

Annex – Transfers from 2016-2018

Aquaculture Licences Issued

2018	2017	2016	3-Year Avg.
22	18	15	18
5	3	5	4
17	11	6	11
53	34	35	41
1	2	1	1
98	68	62	
76			
	22 5 17 53 1	22 18 5 3 17 11 53 34 1 2 98 68	22 18 15 5 3 5 17 11 6 53 34 35 1 2 1 98 68 62

Company	2018	2017	2016	3-Year Avg.
Omega Pacific	2	3	2	2
DFO SEP	468	503	481	484
Shaw Centre for the Salish Sea	1	1	0	1
St'at'imc First Nation	1	0	0	0
FFSBC	3	8	11	7
LGL Ltd	0	1	0	0
MFLNRO	1	4	1	2
ONA	0	5	1	2
Subtotals	476	525	496	
Annual Average Application No.	499			

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Overall Context

Fisheries and Oceans' interim approach on movement of live fish in the context of aquaculture

Global demand for fish and seafood as a high-protein food source has increased significantly in the last decades. This demand is projected to increase as the world's population continues to grow. At the same time, and with pressures on global fish stocks, aquaculture is recognized as having a valuable contribution to food security. Ensuring the sustainable management of Canada's aquatic resources requires a robust regulatory structure and a suite of policies that guide decision-making.

On December 10, 2018, the Minister of Fisheries and Oceans, and the Canadian Coast Guard presented a new vision for aquaculture in Canada and announced the implementation of an area-based approach which would complement a risk-based decision-making framework for aquaculture. These tools ensure that the precautionary approach guides DFO's decision-making and that the industry continues to be environmentally sustainable.

Fisheries and Oceans Canada's new approach to aquaculture means we are continuously seeking the best scientific knowledge and aquaculture management practices available to make significant improvements in the way we regulate the industry to meet the global demand for our farmed seafood products, while making sure our aquatic ecosystems are healthy and wild fish populations are protected.

Achieving these goals requires engagement with Canadians across a broad range of interests; we work with provinces, territories, federal partners, Indigenous Peoples, environmental groups, industry, and members of the public to arrive at informed decisions.

Objective for Sustainable Aquaculture

The Department's goal is to ensure that wild fish and their habitats are protected using tools like avoidance, mitigation, monitoring, compliance and remediation approaches to reduce possible impacts to the environment.

Implementation of an Area-Based Approach

In achieving its objective, it is important to consider local environmental conditions, the status of local wild fish populations and their habitats, and how both interact with aquaculture operations in time and space. Specific local management objectives might also consider cultural and societal values, economic goals, indigenous and local knowledge. In this way, information inputs and management approaches may differ among geographic locations. An area-based approach recognizes that appropriate risk management may require additional mitigation measures in locations where specific geographic or population-level conditions warrant extra consideration.

Framework for Aquaculture Risk Management

DFO has developed a framework for assessing and reducing risk related to the management of aquaculture. This process is rooted in DFO's legislative mandate and is consistent with its Sustainable Fisheries Framework, which provides the foundation for an ecosystem-based and precautionary approach to fisheries management in Canada. The framework for aquaculture risk management relies on the best available science-based risk assessments and analyses, and incorporates risk management approaches to eliminate, minimize, and/or mitigate risks to the environment. On-going monitoring and evaluation of new findings are key components of this framework. By incorporating new information in an on-going

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way, additional interventions can be rapidly applied should any unanticipated environmental or ecosystem change be detected.

Applying the Precautionary Approach

DFO applies precaution at multiple steps of the risk management approach to its decision-making. When assessing risk, it is important to understand the extent of the effect of the activity on fish and fish habitat and the uncertainties associated with the assessment of these effects. When information is less certain or complete, additional management actions are imposed to reduce risk to the wild population and/or to increase the level of certainty that informs decision-making. The most effective precautionary measures are those expected to reduce the risk to the ecosystem or its components.

Addressing Uncertainty

The level of certainty associated with DFO's analyses is clearly described in its science-based risk assessments and analyses. This type of information is critical to decision-making. The greater the uncertainty in our available information, the less confidence DFO may have that the potential impacts of an action can be estimated or predicted accurately. Characterizing how the uncertainty in the data affects the overall assessment, and particularly if it is anticipated to result in an overestimate or underestimate of the assessment, is key. In circumstances where the uncertainties are likely to underestimate the risk, or could either over or under estimate the risk, more risk adverse measures will be implemented and efforts made to increase the level of certainty associated with our evidence base.

Communicating Decisions

A critical component of DFO's new approach to managing aquaculture is the effective communication of the rationale for its decisions. In addition to the development of and consultation on an interim policy suite that describes the DFO decision-making framework for aquaculture in Canada, additional measures are underway to review and communicate the evidence-base for decisions.

An External Advisory Committee, made up of international and domestic technical experts will be engaged to provide DFO with advice on the activities of its aquaculture science program. These efforts will ensure that the best possible science is brought forward to inform the regulation of aquaculture in Canada.

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PROTECTED/

Guidelines on the Interpretation and Application of Section 56 of the Fishery (General) Regulations

Introduction

These guidelines are meant to provide functional direction and guidance to Fisheries and Oceans Canada (DFO) employees in making decisions respecting the issuance of a licence authorizing the transfer of live fish under section 56 of the *Fishery (General) Regulations* (FGR).

These guidelines are not meant to be exhaustive, or in any way fetter the discretion of the Minister¹ of DFO.

Section 56 of the Fishery (General) Regulations

Section 56 of the FGR states that the Minister may issue licences authorizing the transfer of live fish if:

- a. the release or transfer of the fish would be in keeping with the proper management and control of fisheries;
- b. the fish do not have any disease or disease agent that may be harmful to the protection and conservation of fish; and
- c. the release or transfer of the fish will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks.

This means that prior to issuing a licence to transfer live fish, the Minister must be satisfied that each of these three preconditions are met. If the proposed transfer fails to meet either of subsection 56(a), (b) or (c), the Minister cannot issue the licence.

A comprehensive record documenting and demonstrating how each transfer meets these preconditions should accompany the decision-making process.

The present guidelines address each of these three preconditions in turn.

Preliminary note: s. 56 of the FGR decisions must be informed by Canada's Policy for Conservation of Wild Pacific Salmon² (the "Wild Salmon Policy"), and the precautionary approach

DFO is committed to the Wild Salmon Policy and the application of the precautionary approach in its overall management of the fisheries that includes wild Pacific salmon, the enhancement of Pacific salmon that is largely delivered through the Salmonid Enhancement Program (SEP), and aquaculture. The goal, principles, and objectives of the Wild Salmon Policy will guide the regulatory actions of the Department.³ Fisheries, and the courts have held that the precautionary approach informs s. 56 of the FGR decisions.

¹ Note that throughout these Guidelines, reference to the "Minister" includes anyone authorized to make decisions on the Minister's behalf.

² "Canada's Policy for Conservation of Wild Pacific Salmon" (the "Wild Salmon Policy"), at https://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/wsp-pss/policy-politique/strategies-eng.html#strategies,

³ Wild Salmon Policy, page 31

-

The precautionary approach is defined in the Wild Salmon Policy as:

"When used in an advisory context in support of decision-making by the Government of Canada, this term conveys the sense that the advice is provided in situations of high scientific uncertainty. It is intended to promote actions that would result in a low probability of harm that is serious or difficult to reverse."

DFO further articulates its view on how the precautionary approach applies to aquaculture management in DFO's "Framework for Aquaculture Risk Management" and "Fisheries and Oceans' Management of Aquaculture and the Application of the Precautionary Approach".⁵

The precautionary approach should generally guide any decision under s. 56 of the FGR, and these guidelines set out specific guidance on how the precautionary principle informs the interpretation and application of s. 56 of the FGR.

The Wild Salmon Policy articulates that DFO's role as the lead federal agency for aquaculture "is to manage aquaculture so that it is environmentally sustainable, socially responsible, and economically viable. The first principle is to support aquaculture development in a manner consistent with its commitments to ecosystem-based and integrated management, as set out in Departmental legislation, regulations, and policies. This principle reflects the Department's mandate for the conservation of marine resources."

Paragraph 56(a): "the release or transfer of the fish would be in keeping with the proper management and control of fisheries"

Subsection 56(a) of the FGR requires that the Minister consider whether authorizing the release of fish would be consistent with the "proper management and control of fisheries".

This broad concept of "proper management and control of fisheries" relates to the purpose of the *Fisheries Act*. "Fisheries" include wild, SEP, and aquaculture fish. It is well established that the fisheries power includes not only conservation and protection, but also the general "regulation" of the fisheries, including their management and control. The term "fisheries" under s. 91(12) of the *Constitution Act*, 1867 refers to the fisheries as a resource; "a source of national or provincial wealth", "a common property resource" to be managed in the public interest. The fisheries resource includes the animals that inhabit the seas, but it also embraces commercial and economic interests, aboriginal rights and interests, and the public interest in sport and recreation.⁷ The fisheries may be managed on social, economic or other grounds, either in conjunction with steps taken to conserve, protect, and harvest the resource, or simply to carry out social, cultural or economic goals and policies.⁸

⁴ Wild Salmon Policy, page 39

⁵ FARM – get proper citation

⁶ Wild Salmon Policy, page 31

⁷ Ward, 2002, SCC

⁸ Gulf Trollers, 1986, FCA

Beyond the impacts that the transfer may have on the conservation of fish, which is specifically addressed in subsections 56(b) and (c) of the FGR, the Minister must be satisfied that the proposed transfer would be consistent with the proper management and control of the fisheries as a common property resource. This could require, for example, consideration of the social and economic impacts that would result from the transfer. Note, however, that s. 56(a) does not require the Minister to re-assess matters that DFO has already considered – including issues that DFO considered in deciding to issue SEP and aquaculture licenses.

Further, the "management and control of fisheries" could be interpreted to capture any conservation concerns not specifically addressed in s. 56(b) and (c) of the FGR. The Minister should therefore consider whether a proposed transfer poses any risks to the conservation of fish that are not captured by s. 56(b) and (c) (as discussed below). This might include, for example, impacts of the transfer on fish habitat.

- Under this precondition, the Minister must assess the pros and cons of each proposed transfer (other than the matters specifically addressed in paragraphs 56(b) and (c)), and determine whether the transfer would be "in keeping with the proper management and control of fisheries".
- While the courts should show some deference to the Minister in balancing these various interests, the Minister should seek legal advice whenever faced with a complex or contentious decision under subsection 56(a) of the FGR.

Paragraph 56(b) of the FGR's: "the fish do not have any disease or disease agent that may be harmful to the protection and conservation of fish"

Subsection 56(b) of the FGR essentially has two interrelated parts:

- 1) do the fish have any "disease or disease agent"?
- 2) If so, do the fish have a disease or disease agent that "may be harmful to the protection and conservation of fish"?

If the answer to both those questions is "yes", the Minister <u>cannot</u> authorize a transfer of fish under s. 56 of the FGR.

These guidelines are informed by two Federal Court decisions interpreting s. 56(b) of the FGR, which will be referenced in this section: the 2015 *Morton* decision⁹, and the 2019 *'Namgis and Morton* decision.¹⁰

Do the fish have a "disease or disease agent"

Whether fish have a "disease or disease agent" is a question of science. DFO defines "disease" as "an abnormality of structure or function which results in a measureable compromise in physiological or

⁹ Morton v. Canada (Fisheries and Oceans), 2015 FC 575

¹⁰ Morton v. Canada (Fisheries and Oceans), 2019 FC 143

behavioural performance, which is not a direct result of physical injury"..¹¹ DFO defines "disease agent" "as an infectious agent that causes or contributes to the development of a disease".¹²

If DFO scientists advises that an "agent" (e.g. a virus or bacteria) does not have the potential to cause a disease, it would not be a "disease or disease agent" that could potentially result in the transfer being prohibited under 56(b) of the FGR.

The Minister must be satisfied that any decision that an agent is not a "disease agent" is consistent with the precautionary approach — that the decision is informed by an understanding of the risk related to the transfer, is supported by the evidence, and accounts for any scientific uncertainties.

ii. If the fish do have a disease or disease agent, would it be "harmful to the protection and conservation of fish"?

If a fish does have a disease or disease agent, the next step is to determine whether that disease or disease agent "may be harmful to the protection and conservation of fish". While all disease agents may impact the fish carrying the disease to one degree or another, not all diseases or disease agents reasonably "may be harmful to the protection and conservation of fish". This is an important qualifier.

The expression "may be harmful to the protection and conservation of fish" has four components. While we are discussing each component individually, all components must be read together:

(1) "May" in "may be harmful"

The term "may be harmful" means that the disease or the disease agent "might" be harmful. <u>It does not require scientific certainty that the transfer will result in harm, or that harm will even be the likely consequence of the transfer.</u>

That being said, not requiring scientific certainty does not equate to total absence of uncertainty. This means that s. 56(b) does not require absolute scientific certainty that the transfer will <u>not</u> cause harm. Even if there are some dissenting scientific opinions or uncertainties in the evidence, the Minister can weigh the overall evidence and reasonably conclude that the transfer poses a level of risk to fish that is below the "may be harmful" threshold. Any such conclusion must be consistent with the precautionary approach in the way it addresses uncertainties in science, contradictory evidence, and any gaps in knowledge, and must be reasonably supported by the available evidence.

(2) "Protection and conservation"

The Minister interprets "protection and conservation" consistent with the definition of "conservation" in DFO's Wild Salmon Policy:

¹¹ As defined in the the Oxford English Dictionary.

¹² As defined by the World Organization for Animal Health (OIE)

(3) Conservation: The protection, maintenance, and rehabilitation of genetic diversity, species, and ecosystems to sustain biodiversity and the continuance of evolutionary and natural production processes.¹³ "Fish"

The Fisheries Act defines the term "fish" as including (a) parts of fish, (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals. For the application of s. 56 of the FGR, the risk of harm must be assessed with respect to any relevant "fish", including wild, SEP, and aquaculture fish, irrespective of the species, and including crustaceans and marine mammals. A failure to consider any relevant "fish", and to consider their particular status and circumstances, could result in any determination made under s. 56(b) of the FGR being declared unreasonable.

In assessing the risk of a particular transfer, DFO should consider aggregates of fish at a level that will best support a sound, evidence-based decision on the possibility of harm to the protection and conservation of fish.

(4) "Harm" to the "protection and conservation of fish".

Putting the above elements together, the question is whether the transfer of a fish with a disease or disease agent:

- "may" be harmful which does not require that harm will be even the likely consequence of the transfer, but otherwise allows DFO to reasonably determine what level of risk is unacceptable in the circumstances of the transfer, considering the *Wild Salmon Policy* and the precautionary approach in its application of the "Guidance Document" referenced below;
- "protection and conservation" means the "protection, maintenance, and rehabilitation of genetic diversity, species, and ecosystems to sustain biodiversity and the continuance of evolutionary and natural production processes";
- "fish" means risks are assessed in relation to aggregates of fish, and considering any relevant information on the status of any relevant aggregates of fish.

Once it has been reasonably determined that the transfer may cause "harm to the protection and conservation of fish", the Minister cannot additionally require a certain *level* of harm before the transfer is prohibited. A conclusion that the transfer "may cause harm to the conservation or protection of fish" would be sufficient to prohibit the Minister from authorizing a transfer under s. 56(b) of the FGR.

DFO has developed a document titled "Movement of Fish Assessment under FGR Section 56: Guidance Document" (the Guidance Document) to guide DFO staff in assessing whether fish have any disease or disease agent that "may be harmful to the protection and conservation of fish". Through the process set out in the Guidance Document, if the fish being transferred have a disease or disease agent, DFO staff will apply risk matrices that consider both the likelihood of potential impacts and the level of any possible

¹³ Wild Salmon Policy page 38

impacts, and come to a conclusion on the risk of harm to the protection and conservation of any relevant aggregate(s) of wild fish.

If the risk to the conservation of aggregates of fish is assessed as "high", DFO staff will recommend against approving the transfer. If the risk of the transfer is assessed as "low", DFO staff would be signaling that in their view the transfer does not pose a risk such that it "may be harmful to the protection and conservation of fish", and is therefore not prohibited under s. 56(b). If the risk is assessed as "medium", DFO staff will consider the overall evidence regarding the specific decision, any available adaptive management measures, and any uncertainty regarding the evidence, and make a recommendation on whether the proposed transfer "may be harmful to the protection and conservation of fish", bearing in mind the analysis set out in this document.

The Minister must review the assessment carried out under the Guidance Document and ensure that its reasoning and conclusions are consistent with the precautionary approach and any relevant policies such as the Wild Salmon Policy, supported by the available evidence and scientific analysis, and reasonable given the circumstances and the interpretation of s. 56(b) of the FGR set out above.

Paragraph 56(c): "the release or transfer of the fish will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks"

Under s. 56(c) of the FGR, the Minister cannot authorize a release or transfer of fish unless the Minister is satisfied that the release or transfer "will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks". Again, we will look at each of the components of this preconditions, but note that all components must be read together.

(1) "Will not" in "will not have an adverse effect"

The term "will not have" suggests that DFO would need to be conclude with reasonable certainty that the release or transfer of fish will not have an adverse effect on the stock size or genetic characteristic. This threshold is higher than "may" (discussed under s. 56(b) of the FGR, above). But a conclusion that the transfer "will not have an adverse effect" should not reasonably require absolute scientific certainty, so long as such a conclusion is reasonable in light of the evidence and reflects a precautionary approach.

(2) Adverse Effects

The Minister is required to consider if the proposed transfer or release of live fish will have an adverse impact on stock size of fish and the genetic characteristics of fish stocks. The Guidance Document will provide an analysis of any "adverse impacts". An adverse impact should be read as having some type of negative or detrimental impact. Transfers or releases of live fish that are considered by the Minister to make the overall stock weaker, from a quantitative or qualitative perspective, should be viewed as an adverse impact.

(3) "Stock size of fish"

The Guidance Document will provide an analysis of whether a transfer or release of live fish will cause an adverse effect on the size of the stock. If so, the Minister would be prohibited from authorizing the

issuance of a licence under s. 56(c) of the FGR. This means that the transfer would have to be considered to be negative to the overall size of the stock (i.e. quantitative measure).

(4) "Genetic characteristics of fish or fish stocks"

The focus of this part is to prohibit the Minister from releasing or transferring live fish that will cause adverse effects on the genetic characteristics of fish and fish stocks. As mentioned above, an "adverse effect" should be read to mean something negative - in this case, something negative as it relates to the genetic characteristics of the fish and fish stocks (i.e. qualitative measure). The Guidance Document will provide an analysis of whether the transfer will cause adverse effects on the genetic characteristics of fish or fish stocks.

(5) "Fish" and "fish or fish stocks"

Essentially, the approach outlined above to the interpretation of "fish" in s. 56(b) of the FGR should be applied in interpreting "fish" and "fish or fish stocks" in s. 56(c). The *Fisheries Act* definition of the term "fish" would again apply, and require consideration of wild, SEP, and aquaculture fish, irrespective of the species, and including crustaceans, marine mammals, and any other potentially relevant type of fish.

While s. 56 (c) of the FGR refers specifically to "stock size" and "stocks", the reality is that for fish management purposes, DFO defines relevant aggregates based on the best available information recognizing that different species and stocks have different levels and quality of data. Section 56(c) of the FGR should reasonably not be read to require DFO to consider only "stocks" of fish if considering another aggregate (e.g. a conservation unit) would lead to a more reliable conclusion. Instead, under s. 56(c) of the FGR, just as under s. 56(b), DFO should consider aggregates of fish at a level that will best support a sound, evidence-based determination on whether the transfer "will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks".

(6) <u>Determination of whether the transfer "will not have an adverse effect on the stock size of</u> fish or the genetic characteristics of fish or fish stocks"

Just as under s. 56(b) of the FGR, the issue under s. 56(c) of the FGR is not whether the transfer "will not have an adverse effect" on an individual fish, or where potentially certain fish will die. The potential harm that needs to be assessed is at the macro level (i.e. at the fish aggregate level). In order to authorize a transfer under s. 56(c) of the FGR, the Minister must determine that the transfer will not have an adverse effect on the size or genetic characteristics of any relevant aggregates of fish.

DFO's Guidance Document will also be employed by DFO staff in assessing whether "the release or transfer of the fish will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks" under s. 56(c) of the FGR.

If the risk of such adverse effects is assessed as "high", DFO staff will recommend against approving the transfer. If the risk of the transfer is assessed as "low", DFO staff would be signaling that they have concluded that the release or transfer "will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks", and is therefore not prohibited under s. 56(c). If the risk is assessed as "medium", DFO staff will consider the overall evidence regarding the specific decision, any

available adaptive management measures, and any uncertainty regarding the evidence, and make a recommendation on whether the proposed transfer "will not have an adverse effect on the stock size of fish or the genetic characteristics of fish or fish stocks", bearing in mind the analysis set out in this document.

The Minister must review the assessment carried out under the Guidance Document and ensure that its reasoning and conclusions are consistent with the precautionary approach and any relevant policies such as the Wild Salmon Policy, supported by the available evidence and scientific analysis, and reasonable given the circumstances and the interpretation of s. 56(c) of the FGR set out above.

From:

House, Matthew < Matthew. House@justice.gc.ca>

Sent:

May-24-19 10:30 AM

To:

Saumur-Kelly, Maude; McPherson, Arran; Parsons, Jay; Webb, Allison; Lowe, Carmel; Haesevoets, Roderick; Campbell, John P.; Struthers, Alistair; Green, Barry; Krahn, Danielle;

Hubley, Marian; Sharzer, Stephen (DOJ); Quinn, Caroline; Burgetz, Ingrid

Subject:

Attachments:

Importance:

High

All.

Matt

From: Saumur-Kelly, Maude [mailto:Maude.Saumur-Kelly@dfo-mpo.gc.ca]

Sent: Friday, May 24, 2019 1:23 PM

To: McPherson, Arran <arran.McPherson@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>; Haesevoets, Roderick <Roderick.Haesevoets@dfo-mpo.gc.ca>; Campbell, John P. <John.Campbell@dfo-mpo.gc.ca>; Struthers, Alistair <Alistair.Struthers@dfo-mpo.gc.ca>; Green, Barry <Barry.Green@dfo-mpo.gc.ca>; Krahn, Danielle <Danielle.Krahn@dfo-mpo.gc.ca>; Hubley, Marian <Marian.Hubley@dfo-mpo.gc.ca>; Sharzer, Stephen <Stephen.Sharzer@justice.gc.ca>; House, Matthew <Matthew.House@justice.gc.ca>; Quinn, Caroline <Caroline.Quinn@dfo-mpo.gc.ca>; Burgetz, Ingrid <Ingrid.Burgetz@dfo-mpo.gc.ca>

Subject

Importance: High

Hi all.

Thanks.

Maude Saumur-Kelly

Aquaculture Management Directorate 613-991-0255 10N192

Pages 415 to / à 422 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

From: Sent: Dostal, Alexandra May-24-19 2:00 PM

To:

Cc:

Sharzer, Stephen (DOJ); House, Matthew (DOJ); Webb, Allison; Haesevoets, Roderick; Campbell, John P.; Struthers, Alistair; Krahn, Danielle; Parsons, Jay; McPherson, Arran;

Hubley, Marian: Ouinn, Caroline: Lowe, Carmel: Burgetz, Ingrid: Reid, Rebecca

Richter, Julie

Subject:

FW; PRV/Aquaculture documents - Min brief on Monday

Attachments:

Colleagues,

Please find attached the documents that have been shared with the Minister's office for Monday's briefing. Please note

I know we have lots of work ahead, but I did want to pause briefly to say a huge thank you and express my enormous gratitude to all of you for such amazing and tireless work on this file – it's a lot and many moving pieces moving quickly but everyone's huge efforts and wonderful collegiality - across regions and parts of the department - have made it much easier and have been pivotal in helping us move things forward.

Enormous thanks again.

Alix

Alix Dostal

s.19(1)

s.23

613-993-1884

From: Hill, Johanna < Johanna. Hill@dfo-mpo.gc.ca>

Sent: Friday, May 24, 2019 4:39 PM

To: Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>; McPherson, Arran <Arran.McPherson@dfo-mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>

Cc: Richter, Julie <Julie.Richter@dfo-mpo.gc.ca>; Saumur-Kelly, Maude <Maude.Saumur-Kelly@dfo-mpo.gc.ca>; McGill, Stephanie <Stephanie.McGill@dfo-mpo.gc.ca>; Robinson, Connor

<Connor.Robinson@dfo-mpo.gc.ca>; Proctor, Jody <Jody.Proctor@dfo-mpo.gc.ca>; Barker, Tyler <Tyler.Barker@dfo-mpo.gc.ca>; Jarjour, Jasmine <Jasmine.Jarjour@dfo-mpo.gc.ca>; Fogliato, Cara <Cara.Fogliato@dfo-mpo.gc.ca>

Subject: PRV/Aquaculture documents - Min brief on Monday

Hi all,

Attached are the documents that were provided to the Minister for the briefing on Monday.

Thank you kindly,

Johanna

Pages 424 to / à 486 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

From:

Webb. Allison

Sent:

May-26-19 4:09 PM

To:

McPherson, Arran; House, Matthew (DOJ); Dostal, Alexandra; Haesevoets, Roderick; Sharzer,

Stephen (DOJ); Campbell, John P.; Struthers, Alistair; Krahn, Danielle; Parsons, Jay; Hubley,

Marian: Quinn, Caroline: Lowe, Carmel: Burgetz, Ingrid: Reid, Rebecca

Cc:

Richter, Julie

Subject:

Nothing substantive to add except one point in the section that Arran added re

Thanks, Allison

Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture Fisheries Management Branch / Direction de la gestion des pêches Fisheries and Oceans Canada / Pêches et Océans Canada 200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada 604-666-7009

s.21(1)(a)

s.21(1)(b)

- 00

Allison.webb@dfo-mpo.gc.ca

s.23

From: McPherson, Arran < Arran. McPherson@dfo-mpo.gc.ca>

Sent: Sunday, May 26, 2019 8:51 AM

To: House, Matthew (DOJ) <Matthew.House@justice.gc.ca>; Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>; Haesevoets, Roderick <Roderick.Haesevoets@dfo-mpo.gc.ca>; Sharzer, Stephen (DOJ) <stephen.sharzer@justice.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Campbell, John P. <John.Campbell@dfo-mpo.gc.ca>; Struthers, Alistair <Alistair.Struthers@dfo-mpo.gc.ca>; Krahn, Danielle <Danielle.Krahn@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Hubley, Marian <Marian.Hubley@dfo-mpo.gc.ca>; Quinn, Caroline <Caroline.Quinn@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>; Burgetz, Ingrid <Ingrid.Burgetz@dfo-mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>

Cc: Richter, Julie < Julie. Richter@dfo-mpo.gc.ca>

Subject:

Alix, here are my comments too. Note, Jay,

Arran.

From: House, Matthew [mailto:Matthew.House@justice.gc.ca]

Sent: Sunday, May 26, 2019 11:39 AM

To: Dostal, Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca >; Haesevoets, Roderick

<<u>Roderick.Haesevoets@dfo-mpo.gc.ca</u>>; Sharzer, Stephen (DOJ) <<u>stephen.sharzer@justice.gc.ca</u>>; Webb, Allison <<u>Allison.Webb@dfo-mpo.gc.ca</u>>; Campbell, John P. <<u>John.Campbell@dfo-mpo.gc.ca</u>>;

Struthers, Alistair < Alistair. Struthers@dfo-mpo.gc.ca>; Krahn, Danielle < Danielle. Krahn@dfo-

mpo.gc.ca>; Parsons, Jay <<u>Jay.Parsons@dfo-mpo.gc.ca</u>>; McPherson, Arran <<u>Arran.McPherson@dfo-</u>

mpo.gc.ca>; Hubley, Marian < Marian. Hubley@dfo-mpo.gc.ca>; Quinn, Caroline < Caroline. Quinn@dfo-

mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Burgetz, Ingrid < Ingrid.Burgetz@dfo-

mpo.gc.ca>; Reid, Rebecca < Rebecca.Reid@dfo-mpo.gc.ca>

Cc: Richter, Julie < Julie.Richter@dfo-mpo.gc.ca >

Matt

From: Dostal, Alexandra [mailto:Alexandra.Dostal@dfo-mpo.gc.ca]

Sent: Saturday, May 25, 2019 5:28 PM

To: Haesevoets, Roderick < Roderick. Haesevoets@dfo-mpo.gc.ca>; Sharzer, Stephen

<Stephen.Sharzer@justice.gc.ca>; House, Matthew <Matthew.House@justice.gc.ca>; Webb, Allison
Allison.Webb@dfo-mpo.gc.ca>; Campbell, John P. John.Campbell@dfo-mpo.gc.ca>; Struthers, Alistair Alistair.Struthers@dfo-mpo.gc.ca>; Krahn, Danielle Danielle.Krahn@dfo-mpo.gc.ca>; Parsons, Jay Jay.Parsons@dfo-mpo.gc.ca>; McPherson, Arran Arran.McPherson@dfo-mpo.gc.ca>; Hubley, Marian McPherson, Arran Arran.McPherson@dfo-mpo.gc.ca>; Hubley, Marian McPherson, Arran Arran.McPherson@dfo-mpo.gc.ca; Hubley, Marian McPherson, Arran.McPherson@dfo-mpo.gc.ca; Hubley, Marian Arran.McPherson@dfo-mpo.gc.ca; Quinn, Caroline Caroline.Quinn@dfo-mpo.gc.ca; Reid, Rebecca Reid, Reid, Rebecca Reid, Reid, Reid

Cc: Richter, Julie < Julie. Richter@dfo-mpo.gc.ca>

Subject:

Colleagues,

I have incorporated comments received to date (thank you for those!) and made some proposed changes/edits to the document and this has now gone unofficially to the DM and Kevin – I made it clear that this has not been approved by colleagues in the department and nor have you seen this version. The new version is attached so please work off this version if you don't mind.

I am sorry I didn't track change this – you may wish to do a compare to the version Roderick sent this morning if you wish to clearly see the changes from today (they are kind of scattered throughout the document). We would welcome all comments/concerns/questions/edits.

I have promised another version to the DM on Monday of this memo because I think we may need to get a version up to the Minister sometime on Monday.

Thanks all so much for all of your work – and a particular thank you to Roderick who worked very furiously including last night and this morning to get this version together. The DM also sent his thanks along to you all as well after

Alix

Alix Dostal

s.23

613-993-1884

From: Haesevoets, Roderick < Roderick. Haesevoets@dfo-mpo.gc.ca>

Sent: Saturday, May 25, 2019 8:08 AM

To: Dostal, Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca >; Sharzer, Stephen (DOJ)

<stephen.sharzer@justice.gc.ca>; House, Matthew (DOJ) <Matthew.House@justice.gc.ca>; Webb,

Allison <<u>Allison.Webb@dfo-mpo.gc.ca</u>>; Campbell, John P. <<u>John.Campbell@dfo-mpo.gc.ca</u>>; Struthers, Alistair <<u>Alistair.Struthers@dfo-mpo.gc.ca</u>>; Krahn, Danielle <<u>Danielle.Krahn@dfo-mpo.gc.ca</u>>;

mpo.gc.ca>; Parsons, Jay < Jay.Parsons@dfo-mpo.gc.ca>; McPherson, Arran < Arran.McPherson@dfo-

mpo.gc.ca>; Hubley, Marian < Marian. Hubley@dfo-mpo.gc.ca>; Quinn, Caroline < Caroline. Quinn@dfo-

mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Burgetz, Ingrid < Ingrid.Burgetz@dfo-

mpo.gc.ca>; Reid, Rebecca < Rebecca. Reid@dfo-mpo.gc.ca>

Cc: Richter, Julie < Julie.Richter@dfo-mpo.gc.ca>

Subject:

Hi all,

Thank you to everyone for their edits and comments

which is attached here for your weekend reading. ©

Please send any edits/comments to me and Alix.

Happy weekend!

Roderick.

From: Dostal, Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca >

Sent: May-24-19 5:00 PM

To: Sharzer, Stephen (DOJ) <stephen.sharzer@justice.gc.ca>; House, Matthew (DOJ)

< <u>Matthew.House@justice.gc.ca</u>>; Webb, Allison < <u>Allison.Webb@dfo-mpo.gc.ca</u>>; Haesevoets, Roderick

<<u>Roderick.Haesevoets@dfo-mpo.gc.ca</u>>; Campbell, John P. <<u>John.Campbell@dfo-mpo.gc.ca</u>>;

Struthers, Alistair < Alistair. Struthers@dfo-mpo.gc.ca >; Krahn, Danielle < Danielle. Krahn@dfo-

mpo.gc.ca>; Parsons, Jay <<u>Jay.Parsons@dfo-mpo.gc.ca</u>>; McPherson, Arran <<u>Arran.McPherson@dfo-</u>

mpo.gc.ca>; Hubley, Marian < Marian. Hubley@dfo-mpo.gc.ca>; Quinn, Caroline < Caroline. Quinn@dfo-

mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Burgetz, Ingrid < Ingrid.Burgetz@dfo-

mpo.gc.ca>; Reid, Rebecca < Rebecca.Reid@dfo-mpo.gc.ca>

Cc: Richter, Julie < Julie.Richter@dfo-mpo.gc.ca>

Subject: FW: PRV/Aquaculture documents - Min brief on Monday

Colleagues,

Please find attached the documents that have been shared with the Minister's office for Monday's briefing. Please note

I know we have lots of work ahead, but I did want to pause briefly to say a huge thank you and express my enormous gratitude to all of you for such amazing and tireless work on this file – it's a lot and many moving pieces moving quickly but everyone's huge efforts and wonderful collegiality - across regions and parts of the department - have made it much easier and have been pivotal in helping us move things forward.

Enormous thanks again,

s.19(1)

Alix

s.23

Alix Dostal

613-993-1884

From: Hill, Johanna < Johanna. Hill@dfo-mpo.gc.ca>

Sent: Friday, May 24, 2019 4:39 PM

To: Dostal, Alexandra <<u>Alexandra.Dostal@dfo-mpo.gc.ca</u>>; McPherson, Arran <<u>Arran.McPherson@dfo-mpo.gc.ca</u>>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>

Cc: Richter, Julie < Julie.Richter@dfo-mpo.gc.ca >; Saumur-Kelly, Maude < Maude.Saumur-Kelly@dfo-

mpo.gc.ca>; McGill, Stephanie < Stephanie.McGill@dfo-mpo.gc.ca>; Robinson, Connor

<<u>Connor.Robinson@dfo-mpo.gc.ca</u>>; Proctor, Jody <<u>Jody.Proctor@dfo-mpo.gc.ca</u>>; Barker, Tyler

<<u>Tyler.Barker@dfo-mpo.gc.ca</u>>; Jarjour, Jasmine <<u>Jasmine.Jarjour@dfo-mpo.gc.ca</u>>; Fogliato, Cara

< Cara. Fogliato@dfo-mpo.gc.ca>

Subject: PRV/Aquaculture documents - Min brief on Monday

Hi all,	
Attached are the document	ts that were provided to the Minister for the briefing on Monday
Thank you kindly,	
Johanna	
	No information has been removed or severed from this page

Pages 491 to / à 497 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

From:

Lowe, Carmel

Sent:

May-27-19 11:07 AM

To:

Webb, Allison

Subject:

FW: RESPONSE REQUESTED FW: Broughton: Collaborative Research possibilities

I don't think we need someone from your team. – btw do you have dial-in details for the PRV call just now?

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

From: Dickie, Catherine < Catherine. Dickie@dfo-mpo.gc.ca>

Sent: May 27, 2019 11:04 AM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Subject: RESPONSE REQUESTED FW: Broughton: Collaborative Research possibilities

Catherine Dickie

Executive Assistant to the Regional Director Science, Science Branch Fisheries and Oceans Canada | Government of Canada catherine.dickie@dfo-mpo.gc.ca | Tel : 250-729-8369

Adjointe exécutive à la directrice régionale, Direction des sciences Pêches et Océans Canada | Gouvernement du Canada catherine.dickie@dfo-mpo.gc.ca | Tél : 250-729-8369

From: Webb. Allison < Allison. Webb@dfo-mpo.gc.ca >

Sent: May-24-19 9:09 AM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca >

Subject: RE: Broughton: Collaborative Research possibilities

Hi Carmel – I wasn't planning on attending, but am expecting that you are just coing me out of interest. Please let me know if you need someone from our team.

Thanks, Allison

Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture Fisheries Management Branch / Direction de la gestion des pêches

Fisheries and Oceans Canada / Pêches et Océans Canada 200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada 604-666-7009 Allison.webb@dfo-mpo.gc.ca From: Lowe. Carmel < Carmel.Lowe@dfo-mpo.gc.ca> Sent: Friday, May 24, 2019 8:22 AM To: Cc: Mack, James AGRI:EX (James, Mack@gov.bc.ca) : Emiliano Di Cicco <James.Mack@gov.bc.ca>; (emiliano.dicicco@unicam.it) <emiliano.dicicco@unicam.it> Miller-Saunders, Kristi < Kristi.Saunders@dfo-mpo.gc.ca >; MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca >; McCorquodale, Brenda <Brenda.McCorquodale@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca> Subject: Re: Broughton: Collaborative Research possibilities Hi all. For those that have not responded yet could you please do soonest so we can schedule this meeting **Thanks** Carmel Sent from my Bell Samsung device over Canada's largest network. --- Original message ---From: Date: 2019-05-22 4:53 PM (GMT-08:00) To: "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca> Cc: , "Mack, James AGRI:EX (<u>James.Mack@gov.bc.ca</u>)" "Emiliano Di Cicco <James.Mack@gov.bc.ca>, (emiliano.dicicco@unicam.it)" <emiliano.dicicco@unicam.it>, , "Miller-Saunders, Kristi" < Kristi.Saunders@dfompo.gc.ca>, "MacDougall, Lesley" < Lesley.MacDougall@dfo-mpo.gc.ca>, "McCorquodale, Brenda" <<u>Brenda.McCorquodale@dfo-mpo.gc.ca</u>>, "Webb, Allison" <<u>Allison.Webb@dfo-mpo.gc.ca</u>> Subject: Re: Broughton: Collaborative Research possibilities I can only do Tuesday afternoon.

s.19(1)

CERMAQ

Document Released Under the Access to Information Act / Document divulgué en vertu de la Loi sur l'accès à l'information.

Phone +1 250-286-0022 ext. Direct +1 250-286-0022 ext. Mobile

Cermag Canada Ltd. 203 - 919 Island Hwy V9W 2C2 Campbell River, BC, Canada

Cermaq.ca

Facebook

Twitter



Supporting our wild salmon - together.



On May 22, 2019, at

4:47 PM, Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca> wrote:

Hi all.

Following up on our recent exchanges, I am reconnecting to check your availability for a meeting to discuss potential collaborative research topics.

We had suggested May 27-29. Please let me know your availability for the following times:

1-2 pm on Monday May 27

2-3 pm or 3-4 pm on Tuesday May 28

9-10 am on Wednesday 29th.

Also – please let me know if the invite should be extended to others.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

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Government of Canada | Gouvernement du Canada

s.19(1)

The information contained in this message may be CONFIDENTIAL. If you are not the addressee, please notify the sender immediately by return e-mail and then delete this message.

Any unauthorised use, dissemination of the information or copying of this message is prohibited.

From:

Reid. Rebecca

Sent:

May-27-19 11:46 AM

To:

Lowe, Carmel; McPherson, Arran; Kerr, Lisa; Girouard, Louise

Cc:

MacDougall, Lesley; Holmes, John; Kennedy, Eddy; Geiger, Karen

Subject:

RE: Head's Up - Norwegian Ambassador requesting to visit PBS on Friday afternoon.

Hi Carmel - we should think about this a bit. Given our state of work with PRV and testing, I wonder if we have any specific questions we could pose to him that would be helpful? Arran – thoughts on this?

RR

Rebecca Reid

Regional Director General/ Directrice générale régionale

Fisheries and Oceans Canada - Pacific Region/ Pêches et Océans Canada - Région du Pacifique

200-401 Burrard Street / 401, rue Burrard, bureau 200

Vancouver, BC/CB V6C 3S4

Office / Téléphone: 604-666-6098

Cell / Cellulaire:

E-mail/ Courriel: rebecca.reid@dfo-mpo.gc.ca

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: Monday, May 27, 2019 11:42 AM

To: Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; McPherson, Arran <Arran.McPherson@dfompo.gc.ca>; Kerr, Lisa <Lisa.Kerr@dfo-mpo.gc.ca>; Girouard, Louise <Louise.Girouard@dfompo.gc.ca>

Cc: MacDougall, Lesley <Lesley, MacDougall@dfo-mpo.gc.ca>; Holmes, John <John.Holmes@dfompo.gc.ca>; Kennedy, Eddy <Eddy.Kennedy@dfo-mpo.gc.ca>; Geiger, Karen <Karen.Geiger@dfompo.gc.ca>

Subject: Head's Up - Norwegian Ambassador requesting to visit PBS on Friday afternoon.

I have just received a request from the President of VIU – who is hosting the Norwegian Ambassador Anne Kari Hansen Ovind on Friday 31 May. The Ambassador has expressed a desire to visit the Pacific Biological Station for a tour and an overview of our work on "Ocean Heath and Fish Health" from 2:30-4pm.

Assuming that there are no issues with accommodating this request, I propose that one of my managers receive and escort the Ambassador around the facility (I will be at the CRT workshop in Vancouver). Topics covered would be:

Ocean Protection Program - SRKW & Baseline projects;

s.16(2)(c)

- Monitoring MPA's;
- Fish health diagnostics and research;
- Assessing the status of salmon.

Please let me know of any concerns or if I should advise any others in Dept.

Carmel

Carmel Lowe, Ph.D.
Regional Director Science | Directrice régionale des sciences
Fisheries and Oceans Canada | Pêches et Océans Canada
Pacific Biological Station | Station biologique du Pacifique
3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca
Telephone | Téléphone 250-756-7177
Facsimile | Télécopieur 250-729-8360
Government of Canada | Gouvernement du Canada

No information has been removed or severed from this page

Subject: Can we discuss attached asap

Location: 6139900001 (call me)

 Start:
 Wed 29/05/2019 2:00 PM

 End:
 Wed 29/05/2019 2:30 PM

Show Time As: Tentative

Recurrence: (none)

Meeting Status: Not yet responded

Organizer: Moore, Wayne

Required Attendees: Lowe, Carmel; MacDougall, Lesley; Parsons, Jay

MacDougall, Lesley From: May-31-19 7:50 AM Sent: Moore, Wayne; Lowe, Carmel To: Parsons, Jav Cc: RE: 911 - additional work on PRV **Subject:** Hi all - I had a brief in-person discussion with Kristi about this (and other things) yesterday. We didn't get into specifics about how it might work or what would be required, or how much cost, but she's aware that other work is being suggested. Kristi shared the following (somewhat related) information: At this point her response has been a standard "DFO is amenable to exploring research questions of mutual interest and mutual benefit" line, but she has noted that we probably want to put some time into standardizing our method of determining what criteria do we use to evaluate whether we will pursue a research question or not. Wayne: I'll call you right away Leslev From: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca> Sent: May-31-19 7:38 AM To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley.MacDougall@dfompo.gc.ca> Cc: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca> Subject: RE: 911 - additional work on PRV s.21(1)(a) That must be the slogan that gets you up in the morning s.21(1)(b) same same as PRV and Namgis just different parties... From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca> Sent: May 31, 2019 10:35 AM To: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley. MacDougall@dfompo.gc.ca> Cc: Parsons, Jay < Jay. Parsons@dfo-mpo.gc.ca > Subject: Re: 911 - additional work on PRV CRT = Columbia River Treaty

Carmel

Sent from my Bell Samsung device over Canada's largest network.

..... same same as PRV and Namgis just different parties...

----- Original message -----

From: "Moore, Wayne" < Wayne.Moore@dfo-mpo.gc.ca>

Date: 2019-05-31 7:27 AM (GMT-08:00)

To: "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca >, "MacDougall, Lesley" < Lesley.MacDougall@dfo-

mpo.gc.ca>

Cc: "Parsons, Jay" < <u>Jay.Parsons@dfo-mpo.gc.ca</u>>

Subject: RE: 911 - additional work on PRV

Understood. I will call Lesley as I think the test that we need to pass is whether an email has been sent.

Lesley - pls call me as soon as possible. 6139900001

Thanks.

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: May 31, 2019 9:44 AM

To: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca >; MacDougall, Lesley < Lesley. MacDougall@dfo-

mpo.gc.ca>

Cc: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Subject: Re: 911 - additional work on PRV

Wayne

I did not discuss it with Kristi to date (not sure if Lealey did?) - and am in Vancouver today at a CRT w/shop so will not have an opportunity to do this before 10am. (Also not sure but she Lesley will know more and may be able to speak to her if she is around.

Importantly - info below from Kyle indicates that the pathogenicity/virulence research may not be successful.

"Our farm surveillance work does provide prevalence measurements and in collaboration with we are investigating the genetic types that are circulating in BC to better understand the epidemiology of this virus. However it should be noted that although mapping the genetic types may provide clues into virus traffic patterns, it is currently impossible to predict which genetic variants would be pathogenic as molecular virulence factors have not been identified. Consequently, it is more informative to focus on changes in disease prevalence on farms rather than to track the genetic types. In other words, a regular monitoring program such as the audit program run by AMD is the likely the best mechanism for identifying whether there is a noticeable change in pathogenicity or virulence. By conducting screening and typing of the PRV, one may better understand its epidemiology however under our current state of knowledge, this work will not aid as a warning signal to alert of pathogenicity changes."

Carmel s.19(1)
s.21(1)(b)

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Moore, Wayne" < Wayne. Moore@dfo-mpo.gc.ca>

Date: 2019-05-31 6:27 AM (GMT-08:00)

To: "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca >, "MacDougall, Lesley" < Lesley.MacDougall@dfo-

mpo.gc.ca>

Cc: "Parsons, Jay" < <u>Jay.Parsons@dfo-mpo.gc.ca</u>>

Subject: 911 - additional work on PRV

Hi,

Not sure if you have had a chance to thing further about this or share it, but we would really like to be able to say around 10am (PDT) that we have shared the attached with Kristi and are awaiting her reaction. **is this doable?**

As promised, I raised the issue of joint versus departmental research here. It did not get a lot of reaction aside from the fact that she sees this as parallel processes rather than one or the other which is why I have explicitly noted that this is without prejudice to the work that (I hope) we might do in the Broughton context.

W

No information has been removed or severed from this page

Proposed Additional PRV Research

One important concern that has been raised is around how to assess any potential changes in the pathogenicity or virulence of PRV and any associated changes in the responses of Pacific salmon.

Such new research will allow DFO to continue to be vigilant about future risks to Pacific salmon.

DFO could announce / undertake a research study to track PRV and other microbes of known or potential pathogens in wild and farmed fish over time in order to examine if there are any changes in the prevalence or pathogenicity or virulence of these microbes, examine any potential changes in the trends in relation to changing environment conditions, such as temperature and other climate change-related parameters, and if any changes in the trends, assess associated changes in the responses of Pacific salmon. In part, such a study could be undertaken using high-throughput technologies that will allow for rapid analysis of a high number of samples.

The department will continue its own current, ongoing scientific research on PRV. It will also rely on domestic and international experts in this field, and the peer review process, to apply the best science available when making management decisions for Canada's aquaculture sector. Incorporating new research findings in an on-going way is a key component in enabling aquaculture managers to consider additional interventions that can be rapidly applied should any unanticipated environmental or ecosystem change be detected.

The above will also take into account any observations/guidance from the to-beestablished External Advisory Committee on Aquaculture Science.

All of the above is without prejudice to any joint projects that we may decide to undertake in collaboration with external partners and specific First Nations in the context of any bilateral/multi-lateral process.

From: Min info memo Sent:	MacDougall, Lesley May-31-19 8:30 AM	
To:	Webb, Allison; Lowe, (
Subject:		

Thanks Allison!

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: May-31-19 8:29 AM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley.MacDougall@dfo-

mpo.gc.ca>

Subject:

FYI – still some revisions in process, but getting closer. Nothing specific to flag that wouldn't be expected from DFO Science I don't think, but you should verify and discuss with Science NHQ if any concerns or feel free to raise with me.

Thanks, Allison

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: Campbell, John P. < John.Campbell@dfo-mpo.gc.ca>

Sent: Thursday, May 30, 2019 7:55 AM

To: Robinson, Connor < Connor. Robinson@dfo-mpo.gc.ca>

Cc: Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Struthers, Alistair <Alistair.Struthers@dfo-mpo.gc.ca>; Morel, Philippe <Philippe.Morel@dfo-mpo.gc.ca>; Genier, Sylvie <Sylvie.Genier@dfo-mpo.gc.ca>; Richter, Julie <Julie.Richter@dfo-mpo.gc.ca>; Haesevoets, Roderick <Roderick.Haesevoets@dfo-mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; McPherson, Arran <Arran.McPherson@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Sharzer, Stephen (DOJ) <stephen.sharzer@justice.gc.ca>; Levesque, Marie-Pier (DOJ) <marie-pier.levesque@justice.gc.ca>; House, Matthew (DOJ) <Matthew.House@justice.gc.ca>

Subject:

s.21(1)(a)

s.21(1)(b)

s.23

Connor - as requested -

Thx John

Pages 509 to / à 516 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

Pages 517 to / à 526 are duplicates of sont des duplicatas de la page 450

Pages 527 to / à 571 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

From:

MacDougall, Lesley

Sent: To: May-31-19 9:43 AM Moore, Wayne; Lowe, Carmel

Subject:

FW: Proposed PRV research study

Hi both – this just received from Kristi

From: Miller-Saunders, Kristi < Kristi.Saunders@dfo-mpo.gc.ca>

Sent: May-31-19 9:41 AM

To: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Higgins, Mark <Mark.Higgins@dfo-

mpo.gc.ca>

Subject: RE: Proposed PRV research study

Leslie.

While I am all for continued monitoring using high throughput technologies as well as traditional approaches to disease assessments are needed to ensure that we do not miss changes in trends or disease occurrence, I think there are relatively easy measure to put into place NOW that would further minimize these risks.

First, as it appears that double or triple disinfection of the eggs has worked well in significantly decreasing the risk of transmission of PRV and possibly other viruses in freshwater hatcheries (e.g. very low level of coronavirus in Quinsam Chinook this year). This practice should become a requirement for aquaculture and SEP hatcheries, and we should track how well the procedure minimizes levels of viral infection.

Second, it is clear to me that fallowing is likely a main issue in the rapid reinfection of naïve fish moved to salmon net pens, given that at least for PRV, we do not see the same pattern of high infection rates in the Strait of Georgia. Conducting research that would provide empirical evidence to optimise fallowing times is a start, but I think immediate implementation of more stringent area-based fallowing, again for a significant and evidence-based fallowing time period (not the weeks to a few months currently applied), is imperative, and a better understanding of connectivity between farms is paramount to establish boundaries of areas. I know that some very useful work has been done with hydrodynamic models in the Discovery Islands and this should be expanded to other areas, but I believe needs to be additionally populated with eDNA data on Atlantic salmon and infectious agents in these areas, as we discussed in our meeting with the Namgis. This could provide a key solution to reducing infections of a large range of agents that accumulate around high density farming areas.

I think being able to announce new policies on the treatment of eggs and an all in all out fallowing of farms as a proactive measure to reduce the continuous infection cycles on farms and burdens of infective agents that could be transmissible to wild fish would be seen positively by the public. It gets to the issues more broadly and gets the department away from always being on the defensive on why they are not taking action on virus x (in this case PRV, but in future it could be something else). This would be a truly precautionary approach in my view, and a good start towards appeasing the concerned public.

Kristi

From: MacDougall, Lesley Sent: May 31, 2019 8:01 AM

To: Higgins, Mark; Miller-Saunders, Kristi **Subject:** FW: Proposed PRV research study

Hi Mark and Kristi

Kristi – this is the proposed other work that is being kicked around by the ADM, I mentioned it yesterday in our meeting.

My hope was that the collaborative work that is being sketched out right now with the Broughton FN would be our priority, but this suggested work is something that the ADM potentially sees taking place in parallel apparently.

When I first read the description of the work my comment to Carmel was I think it would be very difficult to provide advice on potential changes to virulence with potential links to environmental conditions. I also noted that with my limited understanding of several projects (Kyle's work as well as Kristi's) I thought we were already trying to get at some of these questions but scoped in a more manageable way (e.g. PRV transmission, potential study of pristine vs. industrialized sites and differences in stress responses in each etc).

However, this proposed research isn't going away. I don't have any specific request for your response – YET – but please review the attached document...and expect that there will be some 'ask' coming in the near future....

Thanks Lesley

From: Parsons, Jay < Jay.Parsons@dfo-mpo.gc.ca>

Sent: May-29-19 8:00 AM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley.MacDougall@dfo-

mpo.qc.ca>

Cc: McPherson, Arran < Arran.McPherson@dfo-mpo.gc.ca >; Moore, Wayne < Wayne.Moore@dfo-

mpo.gc.ca>; McGill, Stephanie < Stephanie.McGill@dfo-mpo.gc.ca>

Subject: Proposed PRV research study

Importance: High

Carmel, Lesley,

As part of the approach to moving forward with the response to the decision around future movements of fish and the re-consideration of the "PRV policy", we are proposing that some additional research be undertaken. I am attaching a short, high level perspective on some possible future research and we would like to discuss this with you further and in particular seek your perspective on what a more detailed approach might look like.

We will set up a call to discuss further.

Thank you, Jay

Dickie, Catherine	
From: Sent: To: Cc: Subject:	Timberg, Tim <tim.timberg@justice.gc.ca> May-31-19 10:29 AM MacDougall, Lesley; McPherson, Arran Lowe, Carmel; Webb, Allison</tim.timberg@justice.gc.ca>
TT	
Sent: Friday, May 31, 2019 1 To: Timberg, Tim <tim.timb< th=""><th>Lesley.MacDougall@dfo-mpo.gc.ca> 0:18 AM erg@justice.gc.ca>; McPherson, Arran <arran.mcpherson@dfo-mpo.gc.ca Lowe@dfo-mpo.gc.ca>; Webb, Allison <allison.webb@dfo-mpo.gc.ca></allison.webb@dfo-mpo.gc.ca></arran.mcpherson@dfo-mpo.gc.ca </th></tim.timb<>	Lesley.MacDougall@dfo-mpo.gc.ca> 0:18 AM erg@justice.gc.ca>; McPherson, Arran <arran.mcpherson@dfo-mpo.gc.ca Lowe@dfo-mpo.gc.ca>; Webb, Allison <allison.webb@dfo-mpo.gc.ca></allison.webb@dfo-mpo.gc.ca></arran.mcpherson@dfo-mpo.gc.ca
Lesley	
Sent: Friday, May 31, 2019 9	erg@justice.gc.ca>; Lowe, Carmel < <u>Carmel.Lowe@dfo-mpo.gc.ca</u> >; Webb,
Lesley	
	mberg@justice.gc.ca> sley.MacDougall@dfo-mpo.gc.ca>; Lowe, Carmel < <u>Carmel.Lowe@dfo-</u> sAllison.Webb@dfo-mpo.gc.ca>
Lesley,	
Thank you for getting back s	o quickly.

Tim	

From: MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca >

Sent: Friday, May 31, 2019 9:29 AM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>;

Timberg, Tim < Tim. Timberg@justice.gc.ca>

Subject:

Hello Tim -

Your thoughts? Lesley

Lesley MacDougall

A/Division Manager, Aquatic Diagnostics, Genomics & Technology / Division des diagnostics, la génomique, de la technologie aquatique Fisheries and Oceans Canada / Péches et Océans Canada Pacific Biological Station / Station Biologique du Pacifique Nanaimo, B.C. V9T6N7

250-756-7395

Lesley.MacDougall@dfo-mpo.gc.ca

From: Timberg, Tim

Sent: Friday, May 31, 2019 9:07 AM

To: Webb, Allison; McPherson, Arran; House, Matthew (DOJ); Sharzer, Stephen (DOJ); Dostal, Alexandra

Cc: MacIsaac, Gwen; Ahmadi, Nadima; Parsons, Jay; Lowe, Carmel; Thomson, Andrew

Subject:

Allison,

Tim

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From: Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>

Sent: Friday, May 31, 2019 7:28 AM

To: McPherson, Arran Arran <a href="ma

<Tim.Timberg@justice.gc.ca>; House, Matthew <Matthew.House@justice.gc.ca>; Sharzer, Stephen

<Stephen.Sharzer@justice.gc.ca>; Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>

Cc: MacIsaac, Gwen < Gwen. MacIsaac@justice.gc.ca >; Ahmadi, Nadima

<Nadima.Ahmadi@justice.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Lowe, Carmel

<Carmel.Lowe@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>

Subject:

Thanks, Allison

Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture

Fisheries Management Branch / Direction de la gestion des pêches

Fisheries and Oceans Canada / Pêches et Océans Canada

200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada

604-666-7009

Allison.webb@dfo-mpo.gc.ca

From: McPherson, Arran < Arran. McPherson@dfo-mpo.gc.ca>

Sent: Friday, May 31, 2019 6:43 AM

To: Timberg, Tim < Tim.Timberg@justice.gc.ca>; House, Matthew (DOJ)

<Matthew.House@justice.gc.ca>; Sharzer, Stephen (DOJ) <stephen.sharzer@justice.gc.ca>; Webb.

Allison <Allison.Webb@dfo-mpo.gc.ca>; Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>

Cc: MacIsaac, Gwen < Gwen. MacIsaac@justice.gc.ca >; Ahmadi, Nadima

Nadima.Ahmadi@justice.gc.ca; Parsons, Jay < Jay.Parsons@dfo-mpo.gc.ca; Lowe, Carmel

<Carmel.Lowe@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>

Subject:

Tim and others,

Arran

From: Timberg, Tim [mailto:Tim.Timberg@justice.gc.ca]

Sent: Thursday, May 30, 2019 6:23 PM

To: House, Matthew (DOJ) < Matthew. House@justice.gc.ca >; Sharzer, Stephen (DOJ)

<stephen.sharzer@justice.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Dostal, Alexandra

<a href="mailto: McPherson, Arran Arran.McPherson@dfo-mpo.gc.ca

Cc: MacIsaac, Gwen <Gwen.MacIsaac@justice.gc.ca>; Ahmadi, Nadima

s.23

< <u>Nadima.Anmadi@justice.gc.ca</u> > Subject:						
Litigation Privilege						

Regards,

Tim Timberg
General Counsel
Pacific Regional Office, Vancouver
900 - 840 Howe Street
Vancouver, B.C. V6Z 2S9
National Litigation Sector
Department of Justice Canada / Government of Canada
Tim.timberg@justice.gc.ca / Tel: 604-666-8966

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From:

Lowe, Carmel

Sent:

June-01-19 2:31 PM

To:

Webb. Allison

Cc:

MacDougall, Lesley

Subject:

Re: Broughton mtg. yesterday

Do you have a copy of the 147 q from Namgis? I don't think I saw these either...

Carmel

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Webb, Allison" < Allison. Webb@dfo-mpo.gc.ca>

Date: 2019-06-01 1:30 PM (GMT-08:00)

To: "Lowe, Carmel" <Carmel.Lowe@dfo-mpo.gc.ca>, "Reid, Rebecca" <Rebecca.Reid@dfo-mpo.gc.ca>, "McPherson, Arran" <Arran.McPherson@dfo-mpo.gc.ca>, "Thomson, Andrew" <Andrew.Thomson@dfo-mpo.gc.ca>

Cc: "MacDougall, Lesley" < Lesley. MacDougall@dfo-mpo.gc.ca>

Subject: RE: Broughton mtg. yesterday

Thanks for this summary Carmel. I am a bit behind on following up, but will contact Lesley to chat further about this and understanding how the FN are expecting – if they are – this to fit into a regulatory context in future.

We have the Broughton meeting on June 3rd so I expect that there will be an update there. I am unsure as to whether or not I'll be able to attend due to litigation, but am trying to have one of my managers there at a minimum.

Thanks, Allison

Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture

Fisheries Management Branch / Direction de la gestion des pêches

Fisheries and Oceans Canada / Pêches et Océans Canada

200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada

604-666-7009

Allison.webb@dfo-mpo.gc.ca

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: Wednesday, May 29, 2019 8:32 AM

To: Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; McPherson, Arran <Arran.McPherson@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-

mpo.gc.ca>
Cc: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>
Subject: Broughton mtg. yesterday

Government of Canada | Gouvernement du Canada

All,
For the mtg late yesterday were the only FN reps (neither Bob Chamberlain nor Kelly Speck
participated), MOWI was represented by and Cermaq by
James Mack did accept for BC but was a no show. Lesley, Kristi and I participated for DFO.
We had shared our list of current and proposed fish health research with the parties in advance to seed discussion. presented (verbally) a proposal aligned with a theme posed by in our November call (Density of farms, location, zone of influence) and for which we are also conducting some research (e.g. advanced developments in FVCOM, prevalence and transmission dynamics of PRV in the marine environment). The proposed research would essentially involve conducting eDNA analysis of water samples for correlation with fish tissue samples that are being collected and analyzed as part of the Interim Protocol Monitoring Agreement between the parties. The results offer the potential to assess whether the water analyses can replace traditional methods that require lethal destruction of fish and, importantly to provide insights into the potential connectivity of fish farms. This proposal is also similar to successful research applications for funding our team has under Phase VII GRDI this year.
Kristi spoke enthusiastically in favour of the proposal and most others on call were supportive but industry did raise questions regarding how validation of the eDNA results would be conducted. The parties also expressed a desire to exploit synergies with the Namgis BCSRIF proposals and in particular the one related to transfer of our genome technology to an independent FN lab - such that FN personnel would conduct some of the eDNA analyses as part of their training on the technology. was supportive and indicated a willingness to consider in consultation with Kelly.
also noted that it would be important for FN's that they receive any analyses as soon as they are completed (rather than at end of project) and a desire to involve PSF in the analyses of the results. I indicated that this would not be an issue from DFO perspective and we would seek to ensure all parties had current information on project.
I noted need to evaluate costs and how they might be funded.
Agreed upon next steps were for to draft a research proposal to share with the parties - estimated timeline for this is 1-2 weeks. Kristi to identify costs for sample analyses and to identify potential FN trainees. Carmell over Ph D.
Carmel Lowe, Ph.D. Regional Director Science Directrice régionale des sciences
Fisheries and Oceans Canada Pêches et Océans Canada
Pacific Biological Station Station biologique du Pacifique
3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7 <u>Carmel.Lowe@dfo-mpo.gc.ca</u>
Telephone Téléphone 250-756-7177
Facsimile Télécopieur 250-729-8360

s.19(1)

Dickie, Catherine From: House, Matthew < Matthew. House@justice.gc.ca> Sent: June-02-19 10:46 AM To: Webb, Allison; McPherson, Arran; Thomson, Andrew; Dostal, Alexandra Cc: Lowe, Carmel; Reid, Rebecca; Sharzer, Stephen (DOJ); Parsons, Jay; Moore, Wayne **Subject:** Thanks Allison. I'll be out of touch for a couple of hours Sent from my BlackBerry 10 smartphone on the Bell network. From: Webb, Allison Sent: Sunday, June 2, 2019 1:33 PM To: McPherson, Arran; Thomson, Andrew; Dostal, Alexandra Cc: Lowe, Carmel; House, Matthew; Reid, Rebecca; Sharzer, Stephen; Parsons, Jay; Moore, Wayne Subject: OK perfect. Thanks so much. Sent from my BlackBerry 10 smartphone on the Bell network. From: McPherson, Arran **Sent:** Sunday, June 2, 2019 10:24 AM **To:** Webb, Allison: Thomson, Andrew: Dostal, Alexandra Cc: Lowe, Carmel; House, Matthew (DOJ); Reid, Rebecca; Sharzer, Stephen (DOJ); Parsons, Jay; Moore, Wayne Subject: Hi Allison. Arran From: Webb, Allison Sent: Sunday, June 2, 2019 1:07 PM To: McPherson, Arran <Arran.McPherson@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfompo.gc.ca>: Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca> Cc: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; House, Matthew (DOJ) <Matthew.House@justice.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; Sharzer, Stephen (DOJ) <stephen.sharzer@justice.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Moore, Wayne <Wayne.Moore@dfo-mpo.gc.ca> Subject:

s.23

Thx

Sent from my BlackBerry 10 smartphone on the Bell network.

From: McPherson, Arran

Sent: Sunday, June 2, 2019 10:02 AM **To:** Thomson, Andrew; Dostal, Alexandra

Cc: Lowe, Carmel; House, Matthew (DOJ); Reid, Rebecca; Webb, Allison; Sharzer, Stephen (DOJ); Parsons, Jay; Moore, Wayne
Subject:
Hi Andy,
From: Thomson, Andrew Sent: Sunday, June 2, 2019 12:58 PM To: Dostal, Alexandra < Alexandra.Dostal@dfo-mpo.gc.ca>; McPherson, Arran < Arran.McPherson@dfo-mpo.gc.ca> Cc: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; House, Matthew (DOJ) < Matthew.House@justice.gc.ca>; Reid, Rebecca < Rebecca.Reid@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; Sharzer, Stephen (DOJ) < stephen.sharzer@justice.gc.ca>; Parsons, Jay < Jay.Parsons@dfo-mpo.gc.ca>; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca> Subject
Andrew Thomson Regional Director - Fisheries Management Sent from my mobile device
Original message From: "Dostal, Alexandra" < <u>Alexandra.Dostal@dfo-mpo.gc.ca</u> > Date: 2019-06-02 9:34 AM (GMT-08:00) To: "McPherson, Arran" < <u>Arran.McPherson@dfo-mpo.gc.ca</u> > Cc: "Lowe, Carmel" < <u>Carmel.Lowe@dfo-mpo.gc.ca</u> >, "House, Matthew (DOJ)" < <u>Matthew.House@justice.gc.ca</u> > "Reid, Rebecca" < <u>Rebecca.Reid@dfo-mpo.gc.ca</u> >, "Webb, Allison" < <u>Allison.Webb@dfo-mpo.gc.ca</u> >, "Sharzer, Stephen (DOJ)" < <u>stephen.sharzer@justice.gc.ca</u> >, "Parsons, Jay" < <u>Jay.Parsons@dfo-mpo.gc.ca</u> >, "Moore, Wayne" < <u>Wayne.Moore@dfo-mpo.gc.ca</u> >, "Thomson, Andrew" < <u>Andrew.Thomson@dfo-mpo.gc.ca</u> > Subject:
Cheers,
Sent from my iPhone
> On Jun 2, 2019, at 11:56 AM, McPherson, Arran < Arran.McPherson@dfo-mpo.gc.ca > wrote:
> Thanks Carmel and Matt.
> Allison/Rebecca, Thanks, Arran
>Original Message
> From: Lowe, Carmel > Sent: Sunday, June 2, 2019 11:10 AM > To: House, Matthew (DOJ) < McPherson, Arran < Arran.McPherson@dfo-mpo.gc.ca; Dostal, Alexandra < Allison.Webb@dfo-mpo.gc.ca; Reid, Rebecca < Reid@dfo-mpo.gc.ca; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca
mpo.gc.ca> > Cc: Sharzer. Stephen (DOJ) <stephen.sharzer@iustice.gc.ca>: Parsons. Jay <jay.parsons@dfo-mpo.gc.ca>: Moore. Wayne</jay.parsons@dfo-mpo.gc.ca></stephen.sharzer@iustice.gc.ca>

< <u>Wayne.Moore@dfo-mpo.gc.ca</u> > > Subject: >
> >
 Carmel Carmel Lowe, Ph.D. Regional Director Science Directrice régionale des sciences Fisheries and Oceans Canada Pêches et Océans Canada Pacific Biological Station Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7 <u>Carmel.Lowe@dfo-mpo.gc.ca</u> Telephone Téléphone 250-756-7177 Facsimile Télécopieur 250-729-8360 Government of Canada Gouvernement du Canada
> From: House, Matthew [Matthew.House@justice.gc.ca] > Sent: Sunday, June 02, 2019 8:03 AM > To: McPherson, Arran; Dostal, Alexandra; Reid, Rebecca; Webb, Allison > Cc: Sharzer, Stephen (DOJ); Parsons, Jay; Moore, Wayne; Lowe, Carmel > Subject:
> Matt > From: House, Matthew > Sent: Sunday, June 02, 2019 10:29 AM > To: 'McPherson, Arran' < Arran.McPherson@dfo-mpo.gc.ca>; Dostal, Alexandra < Alexandra.Dostal@dfo-mpo.gc.ca>; Reid, Rebecca < Rebecca.Reid@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca> > Cc: Sharzer, Stephen < Stephen.Sharzer@justice.gc.ca>; Parsons, Jay < Jay.Parsons@dfo-mpo.gc.ca>; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca> > Subject: >
> Thanks, > Matt
> From: McPherson, Arran [mailto:Arran.McPherson@dfo-mpo.gc.ca] > Sent: Sunday, June 02, 2019 10:01 AM > To: Dostal, Alexandra Alexandra.Dostal@dfo-mpo.gc.ca>>; House, Matthew <a href="mailto:Matthew.House@justice.gc.ca<mailto:Matthew.House@justice.gc.ca">Matthew.House@justice.gc.caMatthew.House@justice.gc.caMatthew.House@justice.gc.caMatthew.House@justice.gc.ca<a href="mailto:Allison.Webb@dfo-mpo.gc.ca<mailto:Allison.Webb@dfo-mpo.gc.ca<mailto:Allison.Webb@dfo-mpo.gc.ca<a href=" mailto:allison.webb@dfo-mpo.gc.ca<mailto:allison.webb@dfo-mpo.gc.ca"="">Matthew.House@justice.gc.ca<a href="mailto:Allison.Webb@dfo-mpo.gc.ca<mailto:Allison.Webb@dfo-mpo.gc.ca<mailto:Allison.Webb@dfo-mpo.gc.ca<">Mailto:Allison.Webb@dfo-mpo.gc.ca<mailto:allison.webb@dfo-mpo.gc.caMatthew.House@justice.gc.ca<a href="mailto:Allison.Webb@dfo-mpo.gc.ca<mailto:Allison.Webb@dfo-mpo.gc.ca<">Mailto:Allison.Webb@dfo-mpo.gc.caMailto:Allison.Webb@dfo-mpo.gc.caMailto:Allison.Webb@dfo-mpo.</mailto:allison.webb@dfo-mpo.gc.ca<a>
mpo.gc.ca <manto.jay.rarsons@uto-mpo.gc.ca>>, Moore, wayne.wa</manto.jay.rarsons@uto-mpo.gc.ca>
> Hi everyone, > :
: >
Tks. Arran. s.23
> From: Dostal, Alexandra > Sent: Sunday, June 2, 2019 9:52 AM > To: House, Matthew (DOJ) < Matthew. House@justice.gc.ca < mailto: Matthew. House@justice.gc.ca >> > Cc: Webb, Allison < Alison. Webb@dfo-mpo.gc.ca < mailto: Arran McPherson@dfo-mpo.gc.ca >>: Reid Rebecca < Reid@dfo-mpo.gc.ca Reid@dfo-mpo.gc.ca < Reid@dfo-mpo.gc.ca >>: Reid Rebecca >>: Reid Rebecca < Reid@dfo-mpo.gc.ca >>: Reid Rebecca >>: Reid

stephen sharzer@justice.gc.ca <mailto.stephen.sharzer@justice.gc.ca>></mailto.stephen.sharzer@justice.gc.ca>	
> Subject:	
>	
1	
> Sent from my iPhone	
>	
> On Jun 2, 2019, at 9:42 AM, House, Matthew < Matthew. House @justice.gc	.ca <mailto house(a="" justice.gc.ca="" matthew="">> wrote:</mailto>
> Solicitor client and litigation privilege	
>	
>	
> Matt	
>	
> From: Timberg, Tim	
> Sent: Saturday, June 01, 2019 7:11 PM	
> To: 'Webb, Allison' < Allison. Webb@dfo-mpo.gc.ca <mailto. allison.="" td="" webb@<=""><td>adfo-mpo oc co>>: Dostal Alexandra</td></mailto.>	adfo-mpo oc co>>: Dostal Alexandra
<a href="Alexandra.Dostal@dfo-mpo.gc.ca<mailto:Alexandra.Dostal@dfo-mpo.gc.ca<mailto:Alexandra.Dostal@dfo-mpo.gc.ca</td><td></td></tr><tr><th>mpo gc_ca<mailto Arran McPherson@dfo-mpo.gc.ca>>; Reid, Rebecca < Reb</th><th></th></tr><tr><th>mpo.gc.ca>></th><th>occurrence ato imporgeres manorite occes. Rendigato</th></tr><tr><td>> Cc: Sharzer, Stephen < Stephen Sharzer@justice.gc.ca<mailto.Stephen Sharzer@justice.gc.gc.gc.gc.gc.gc.gc.gc.gc.gc.gc.gc.gc.</td><td>zer(a)ustice gc ca>>: House, Matthew</td></tr><tr><th>MatthewHouse@justice.gc.ca >; MatthewHouse@justice.gc.ca>; MatthewHouse@justice.gc.ca>>; MatthewHouse@justice.gc <th></th>	
<gwen macisaac@justice.gc.ca="" macisaac@justice.gc.ca<mailto:gwen="">>; Al</gwen>	
<nadima. ahmadi@justice="" ahmadi@justice.gc.ca="" ca<mailto:="" gc="" nadima.="">></nadima.>	
> Subject:	
>	
> Litigation Privilege	
>	
> DFO,	
>	
>	
>	
>	
> Many thanks,	
>	
>	
> Tim Timberg	s.23
> General Counsel	-
> Pacific Regional Office, Vancouver	
> 900 - 840 Howe Street	

- > Vancouver, B.C. V6Z 2S9
- > National Litigation Sector
- > Department of Justice Canada / Government of Canada Tim.timberg@justice.gc.ca<mailto:Tim.timberg@justice.gc.ca> / Tel: 604-666-8966 This communication contains information that may be confidential, exempt from disclosure, subject to litigation privilege or protected by the privilege that exists between lawyers or notaries and their clients. If you are not the intended recipient, you should not read, rely on, retain, or distribute it. Please delete or otherwise destroy this communication and all copies of it immediately, and contact the sender at (telephone number) or by email at (email).
- > Ce message contient des renseignements qui pourraient être confidentiels, soustraits à la communication, ou protégés par le privilège relatif au litige ou par le secret professionnel liant l'avocat ou le notaire à son client. S'il ne vous est pas destiné, vous êtes priés de ne pas le lire, l'utiliser, le conserver ou le diffuser. Veuillez sans tarder le supprimer et en détruire toute copie, et communiquer avec l'expéditeur au (no. de téléphone) ou à (courriel).

> >

No information has been removed or severed from this page

From: Reid, Rebecca
Sent: June-02-19 8:49 PM

To: Thomson, Andrew; Lowe, Carmel; Webb, Allison
Cc: Fogliato, Cara; Johal, Sharan; Antcliffe, Bonnie

Subject: FW: Engagement Plan PRV

Attachments: Proposed pre- PRV policy announcement bilats - DRAFT 31May2019 v3.docx

FYI – our proposed engagement plan for the PRV decision.

Rebecca Reid

Regional Director General/ Directrice générale régionale

Fisheries and Oceans Canada - Pacific Region/ Pêches et Océans Canada - Région du Pacifique

200-401 Burrard Street / 401, rue Burrard, bureau 200

Vancouver, BC/CB V6C 3S4
Office / Téléphone: 604-666-6098
Cell / Cellulaire:

Email Commists

E-mail/ Courriel: rebecca.reid@dfo-mpo.gc.ca

From: Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>

Sent: Sunday, June 2, 2019 6:32 PM

To: Richter, Julie < Julie. Richter@dfo-mpo.gc.ca>

Cc: Saumur-Kelly, Maude <Maude.Saumur-Kelly@dfo-mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-

mpo.gc.ca>; Morel, Philippe <Philippe.Morel@dfo-mpo.gc.ca>; Struthers, Alistair

<Alistair.Struthers@dfo-mpo.qc.ca>: Haesevoets. Roderick <Roderick.Haesevoets@dfo-mpo.qc.ca>:

Dostal, Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca>

Subject: Engagement Plan PRV

Julie, on Monday morning could you please send this document to DMO for the Minister's office? DMO is expecting it and it was requested by MINO in advance of Tuesday. It has been approved by Philippe and Rebecca.

Thank you!

Alix

Roderick – if you could send this document to the team for this file so they are aware that would be great.

Alix

Alix Dostal

Director General, Aquaculture Management Directorate | Directrice générale, Direction de la gestion de l'aquaculture

Aquaculture Management Directorate | Direction de la gestion de l'aquaculture

Telephone | Téléphone: 613-993-1884 Alexandra.Dostal@dfo-mpo.gc.ca

Government of Canada | Gouvernement du Canada

s.16(2)(c)

Proposed Senior Management Bilateral Engagements Immediately Prior to "PRV Policy" Announcement

The following document outlines proposed Minister or Deputy Minister -level engagements to take place in advance of the PRV-related announcements on or before June 4, 2019. This engagement will involve a series of bilateral discussions with key provincial officials, Indigenous leaders, and stakeholders regarding DFO's enhanced FGR s.56 decision-making approach.

Timing of these discussions is likely June 3, 2019 (TBD).

Proposed bilateral discussions

Official	Contact Information	Proposed level of bilat.	
Other federal departments			
Siddika Mithani, President, Canadian Food Inspection Agency	Tel: 613-773-6000 E-mail: siddika.mithani@canada.ca	Deputy Minister	
Provincial/territorial governments			
Lana Popham, Minister of Agriculture, British Columbia	Tel: 250-387-1023 E-mail: agr.minister@gov.bc.ca	Minister	
Cathy LaRochelle, Deputy Minister of Agriculture, Aquaculture and Fisheries, New Brunswick	Tel: 506-453-2666 E-mail: cathy.larochelle@gnb.ca	Deputy Minister	
Frank Dunn, Deputy Minister of Fisheries and Aquaculture	Tel: 902-424-0301 E-mail: frank.dunn@novascotia.ca	Deputy Minister	
Lori Anne Companion, Deputy Minister of Fisheries and Land Resources, Newfoundland and Labrador	Tel: 709-729-3707 E-mail: loriannecompanion@gov.nl.ca	Deputy Minister	
Optional: teleconference of the CCFAN	M Deputy Ministers		
Indigenous groups			
Don Svanvik , Chief, 'N <u>a</u> mgis First Nation	Tel: 250-974-5556 (general line) E-mail: chief@namgis.bc.ca	Andrew Thompson	
Assembly of First Nations National Fisheries Committee / National Aquaculture Working Group	Tel: 613-241-6789 (AFN general line) E-mail:	Philippe Morel	
First Nations Fisheries Council of British Columbia	Tel: 778-379-6470 (general line) Email :	Rebecca Reid	

s.19(1)

First Nations Fisheries Council of British Columbia's Aquaculture Coordinating Committee coordinator	Tel: 778-379-6470 x and cell E-mail:	
Industry		
Canadian Aquaculture Industry Association	Tel: 613-239-0612 x E-mail:	Philippe Morel
British Columbia Salmon Farmer's Association	Tel: 250-286-1636 E-mail:	Rebecca Reid
Others		
	Tel: E-mail:	Minister

From:

Lowe, Carmel

Sent:

June-03-19 3:14 PM

To:

MacDougall, Lesley

Subject:

latest on PRV

No information has been removed or severed from this page

Subject: PRV: Technical Briefing for Media **Location:** Executive Boardroom - 15th floor

Start: Tue 04/06/2019 1:30 PM

End: Tue 04/06/2019 2:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: Bate, Dan

Required Attendees: Reid, Rebecca; Thomson, Andrew; Parsons, Jay; PAC RDGExecScheduler /

ExecCalendrierDGR PAC (DFO/MPO)

Optional Attendees: MacDougall, Lesley; Lowe, Carmel; McCorquodale, Brenda

Moderator/Guest speakers:

Toll-free dial-in number (Canada/US): 1-877-413-4813 Local dial-in number: 613-960-7525

From:

Fogliato, Cara on behalf of Reid, Rebecca

Sent:

June-04-19 1:30 PM

To:

Parsons, Jay; Lowe, Carmel; MacDougall, Lesley; McCorquodale, Brenda; Bate, Dan

Subject:

FW: FYI - Interim approach to developing advice to authorize live fish movements (re: PRV

Court Case)

Here is the news release as well.

Sarah Pringle for:

Cara Fogliato

A/Executive Assistant to the Regional Director General/ Assistant Exécutif au Directrice Général Régional

Tel: 604-666-1376/Fax: 604-666-8956

From: Richter, Julie < Julie. Richter@dfo-mpo.gc.ca > On Behalf Of Morel, Philippe

Sent: June-04-19 1:14 PM

To: Morel, Philippe <Philippe.Morel@dfo-mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; Gilbert, Scott <Scott.Gilbert@dfo-mpo.gc.ca>; Nirlungnayuq, Gabriel <Gabriel.Nirlungnayuq@dfo-mpo.gc.ca>; Vincent, Patrick <Patrick.Vincent@dfo-mpo.gc.ca>; Doucet, Serge <Serge.Doucet@dfo-mpo.gc.ca>; Valkenier, Mary-Ellen <Mary-Ellen.Valkenier@dfo-mpo.gc.ca>; Perry, Jacqueline <Jacqueline.Perry@dfo-mpo.gc.ca>

Cc: Dostal, Alexandra <a learning and a learning an

FYI: Please find attached the news release, to be issued shortly:



NR_AE_AQUA_C...

Case)

From: Morel, Philippe

Sent: Tuesday, June 4, 2019 2:42 PM

To: Reid, Rebecca Reid@dfo-mpo.gc.ca; Gilbert, Scott Scott.Gilbert@dfo-mpo.gc.ca; Nirlungnayuq, Gabriel Gabriel.Nirlungnayuq@dfo-mpo.gc.ca; Vincent, Patrick Patrick.Vincent@dfo-mpo.gc.ca; Valkenier, Mary-Ellen Mary-Ellen <a href="Mary-Ellen <a href="Mary-Ellen

RDG Colleagues,

On February 4, 2019, the Federal Court issued its judgement on Morton and 'Namgis, which quashed DFO's decision not to require testing for PRV prior to authorizing movements of live fish under FGR s.56. The judgement was suspended until June 4 to allow DFO to reconsider its policy. On June 3, the Court granted DFO an extension until September 3, 2019. To address the Court's findings and as part of our ongoing protection of wild fish stocks, DFO has developed a series of new initiatives, which will be announced later today. The News Release and other communications products are being finalized; I will share them with you as soon as they are approved.

Plus précisément, le ministère publiera deux documents intérimaires sur la gestion des risques visant l'amélioration de ses processus de prise de décisions. Le gouvernement sollicitera les commentaires du public sur ces deux documents sur une période de 60 jours (du 4 juin au 2 août).

Document	Objective of Document	English	Français
Framework for Aquaculture Risk Management (FARM)	The interim FARM explains how DFO applies the precautionary approach in decision making in aquaculture in Canada, and how environmental risk from aquaculture activities will be mitigated to ensure the protection of wild fish.	<pre><< File: TAB 6 - Overall Context document - DRAFT 04Jun2019 - tracked - FR.docx >></pre>	<pre><< File: TAB 6 - Overall Context document - DRAFT 04Jun2019 - tracked - EN.docx >></pre>
Risk-based approach on the movement of live fish under section 56 of the Fishery (General) Regulations	This interim framework is aligned with the FARM and provides guidance on the authorization on the movement of live fish. It considers a number of factors, such as the state of wild stocks in the area, recent health of farmed fish to be transferred, extent of exposure of the wild stocks to the farm, Indigenous traditional knowledge, and mitigation measures to protect wild fish.	<< File: TAB 2 - Fisheries and Oceans Framework for Aquaculture Risk Managment Complete Documentation - DRAFT 04Jun2019 - clean - FR.pdf >>	<pre><< File: TAB 2 - Fisheries and Oceans Framework for Aquaculture Risk Managment Complete Documentation - DRAFT 04Jun2019 - clean - EN.pdf >></pre>

Ces deux documents sont des ébauches pour l'instant et ne s'appliqueront à l'échelle du Canada (en respectant les champs de compétences des provinces) que suite aux consultations et que les commentaires des provinces, des partenaires autochtones et des parties prenantes soient incorporés. Les sous-ministres de l'Atlantique ont été informés ce matin.

Additionally, in order to be precautionary, DFO will also be requiring industry in BC to implement two key measures: enhanced testing and reporting of HSMI and Jaundice syndrome, and, screening of salmon hatcheries for two strains of PRV (non-native Icelandic and Norwegian strains). DFO will also be increasing its audits at farm sites to confirm accuracy of industry reporting. DFO will also be undertaking additional auditing through the Fish Health Audit and Intelligence Program to verify industry information and ensure compliance with these new requirements. DFO will evaluate this new information as well as other science information

as we continue to use adaptive management to ensure that we are continuing to improve our regulation of the aquaculture industry and protection of wild fish.

L'orientation à long terme de cette industrie inclura la mise en œuvre d'innovations technologiques et d'approches sectorielles qui tiennent compte des points de vue des communautés autochtones et des parties prenantes. Vous trouverez ci-dessous des informations contextuelles additionnelles (qui seront également publiées en ligne aujourd'hui), ainsi que le plan d'engagement proposé et une ébauche de points d'allocutions concernant cette nouvelle approche.

Document	English	Français
Overall Context	<pre><< File: Proposed pre- PRV policy announcement bilats - DRAFT 3June2019final.docx >></pre>	File: TAB 1 Interim decision- making framework for developing advice on the movement of live fish under FGR s56 - DRAFT 04Jun2019 - tracked - FR.docx >>
Proposed Senior Management Bilateral Engagements Immediately Prior to "PRV Policy" Announcement	<pre><< File: TAB 1 - Interim decision- making framework for developing advice on the movement of live fish under FGR s56 - DRAFT 04Jun2019 - tracked - EN.docx >></pre>	Non- disponible

This work is a result of intensive work and collaboration between Aquaculture management and Aquaculture Science teams in HQ and Pacific region. I wish to recognize the excellent work by all those who contributed and collaborated.

We have briefed Regional Aquaculture Management Offices. Nous continuerons de tenir les Bureaux régionaux de gestion de l'aquaculture au courant au fur et à mesure que l'initiative évolue et nous les aiderons à répondre à toute question éventuelle.

Merci.

Philippe

Philippe Morel

Sous-ministre adjoint – Écosystèmes aquatiques Pêches et Océans Canada 200, rue Kent Étage 10, Pièce S035 Ottawa, Ontario K1A 0E6 Courriel: Philippe.Morel@dfo-mpo.gc.ca

Téléphone: 613-993-1914

Philippe Morel

Assistant Deputy Minister – Aquatic Ecosystems Fisheries and Oceans Canada 200 Kent St. 10th Floor, Room S035 Ottawa (Ontario) K1A 0E6

e-mail: Philippe.Morel@dfo-mpo.gc.ca

Phone: 613-993-1914

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Fisheries and Oceans Canada

Available at

https://www.canada.ca/en/fisheries-oceans/news/2019/06/government-of-canada-takes-further-action-to-enhance-aquaculture -sustainability-in-british-columbia.html

News Release

For Immediate Release

Government of Canada takes further action to enhance aquaculture sustainability in British Columbia

June 4, 2019

Ottawa, Ontario

Fisheries and Oceans Canada



Pages 595 to / à 596 are withheld pursuant to section sont retenues en vertu de l'article

68(a)

of the Access to Information Act de la Loi sur l'accès à l'information

From:

Fogliato, Cara on behalf of Reid, Rebecca

Sent:

June-04-19 1:32 PM

To:

Parsons, Jay; Lowe, Carmel; MacDougall, Lesley; McCorquodale, Brenda; Bate, Dan

Subject:

FW: FYI - Interim approach to developing advice to authorize live fish movements (re: PRV

Court Case)

Some more info

Sarah Pringle for:

Cara Fogliato

A/Executive Assistant to the Regional Director General/ Assistant Exécutif au Directrice Général Régional

Tel: 604-666-1376/Fax: 604-666-8956

From: Morel, Philippe < Philippe. Morel@dfo-mpo.gc.ca>

Sent: June-04-19 11:42 AM

To: Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; Gilbert, Scott <Scott.Gilbert@dfo-mpo.gc.ca>; Nirlungnayuq, Gabriel <Gabriel.Nirlungnayuq@dfo-mpo.gc.ca>; Vincent, Patrick <Patrick.Vincent@dfo-mpo.gc.ca>; Doucet, Serge <Serge.Doucet@dfo-mpo.gc.ca>; Valkenier, Mary-Ellen <Mary-Ellen.Valkenier@dfo-mpo.gc.ca>; Perry, Jacqueline <Jacqueline.Perry@dfo-mpo.gc.ca> Cc: Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>; Richter, Julie <Julie.Richter@dfo-mpo.gc.ca>; Struthers, Alistair <Alistair.Struthers@dfo-mpo.gc.ca>; Medeiros, Dean <Dean.Medeiros@dfo-mpo.gc.ca>; Haesevoets, Roderick <Roderick.Haesevoets@dfo-mpo.gc.ca>; McPherson, Arran <Arran.McPherson@dfo-mpo.gc.ca> Subject: FYI - Interim approach to developing advice to authorize live fish movements (re: PRV Court Case)

RDG Colleagues,

On February 4, 2019, the Federal Court issued its judgement on Morton and 'Namgis, which quashed DFO's decision not to require testing for PRV prior to authorizing movements of live fish under FGR s.56. The judgement was suspended until June 4 to allow DFO to reconsider its policy. On June 3, the Court granted DFO an extension until September 3, 2019. To address the Court's findings and as part of our ongoing protection of wild fish stocks, DFO has developed a series of new initiatives, which will be announced later today. The News Release and other communications products are being finalized; I will share them with you as soon as they are approved.

Plus précisément, le ministère publiera deux documents intérimaires sur la gestion des risques visant l'amélioration de ses processus de prise de décisions. Le gouvernement sollicitera les commentaires du public sur ces deux documents sur une période de 60 jours (du 4 juin au 2 août).

Document	Objective of Document	English	Français

Framework for Aquaculture Risk Management (FARM)	The interim FARM explains how DFO applies the precautionary approach in decision making in aquaculture in Canada, and how environmental risk from aquaculture activities will be mitigated to ensure the protection of wild fish.	TAB 2 - Fisheries and Oceans F	TAB 2 - Fisheries and Oceans F
Risk-based approach on the movement of live fish under section 56 of the Fishery (General) Regulations	This interim framework is aligned with the FARM and provides guidance on the authorization on the movement of live fish. It considers a number of factors, such as the state of wild stocks in the area, recent health of farmed fish to be transferred, extent of exposure of the wild stocks to the farm, Indigenous traditional knowledge, and mitigation measures to protect wild fish.	TAB 1 - Interim decision-makin	TAB 1 - Interim decision-makin

Ces deux documents sont des ébauches pour l'instant et ne s'appliqueront à l'échelle du Canada (en respectant les champs de compétences des provinces) que suite aux consultations et que les commentaires des provinces, des partenaires autochtones et des parties prenantes soient incorporés. Les sous-ministres de l'Atlantique ont été informés ce matin.

Additionally, in order to be precautionary, DFO will also be requiring industry in BC to implement two key measures: enhanced testing and reporting of HSMI and Jaundice syndrome, and, screening of salmon hatcheries for two strains of PRV (non-native Icelandic and Norwegian strains). DFO will also be increasing its audits at farm sites to confirm accuracy of industry reporting. DFO will also be undertaking additional auditing through the Fish Health Audit and Intelligence Program to verify industry information and ensure compliance with these new requirements. DFO will evaluate this new information as well as other science information as we continue to use adaptive management to ensure that we are continuing to improve our regulation of the aquaculture industry and protection of wild fish.

L'orientation à long terme de cette industrie inclura la mise en œuvre d'innovations technologiques et d'approches sectorielles qui tiennent compte des points de vue des communautés autochtones et des parties prenantes. Vous trouverez ci-dessous des informations contextuelles additionnelles (qui seront également publiées en ligne aujourd'hui), ainsi que le plan d'engagement proposé et une ébauche de points d'allocutions concernant cette nouvelle approche.

Document	English	Français
Overall Context	Will	w min
	TAB 6 - Overall	TAB 6 - Overall
	Context docum	Context docum
Proposed	W	Non-
Senior		disponible
Management	Proposed pre- PRV policy anno	
Bilateral	PRV policy anno	
Engagements		
Immediately	,	
Prior to "PRV		
Policy"		

Announcement

This work is a result of intensive work and collaboration between Aquaculture management and Aquaculture Science teams in HQ and Pacific region. I wish to recognize the excellent work by all those who contributed and collaborated.

We have briefed Regional Aquaculture Management Offices. Nous continuerons de tenir les Bureaux régionaux de gestion de l'aquaculture au courant au fur et à mesure que l'initiative évolue et nous les aiderons à répondre à toute question éventuelle.

Merci.

Philippe

Philippe Morel

Sous-ministre adjoint – Écosystèmes aquatiques Pêches et Océans Canada 200, rue Kent Étage 10, Pièce S035 Ottawa, Ontario K1A 0E6

Courriel: Philippe.Morel@dfo-mpo.gc.ca

Téléphone: 613-993-1914

Philippe Morel

Assistant Deputy Minister – Aquatic Ecosystems Fisheries and Oceans Canada 200 Kent St. 10th Floor, Room S035 Ottawa (Ontario) K1A 0E6

e-mail: Philippe.Morel@dfo-mpo.gc.ca

Phone: 613-993-1914

From:	MacDougall, Lesley
Sent:	June-04-19 2:28 PM
To:	Fogliato, Cara; Reid, Rebecca
Cc:	Thomson, Andrew; Lowe, Carmel
Subject:	RE: Speaking Notes for PRV
sequencing of the endemic found what would be the rest highlighted the technical was decision making FW documento know if the genomics lab DFO that have a responsibil noted on several	key questions at this point were is DFO going to release the full genomic PRV strain (said I was uncertain where we were with that), and if PRV was sponse (used the answer from the Q+A). Working groups that are being developed, I noted that the FARM and interiments are now live for input (she already had copies). She was also interested would be involved in implementing the approach – I noted that all parts of
Lesley	
	sley.MacDougall@dfo-mpo.gc.ca> lrew.Thomson@dfo-mpo.gc.ca>
Hi Lesley,	
Rebecca has requested that briefings regarding PRV. I'n RR's speaking notes attache	n not sure if Andy has already spoken to you about this or not, but please find
Let me know if you need a	nything further information,
Sarah	
Sarah Pringle for: Cara Fogliato A/Executive Assistant to the Region Tel: 604-666-1376/Fax: 604-666-8	onal Director General/ Assistant Exécutif au Directrice Général Régional 1956

s.19(1)

Dickie, Catherine From: Girouard, Louise Sent: June-05-19 4:09 AM To: Reid, Rebecca; Thomson, Andrew; Webb, Allison; Bate, Dan; Rainer, Michelle; Imbeau, Michelle: Lowe. Carmel Cc: Johal, Sharan Subject: Fwd: Merci on PRV!! Passing on thanks from Mino. Very well done everyone. Merci! L ----- Original message -----From: "Des Rosiers, Marie-Pascale" < Marie-Pascale. Des Rosiers @dfo-mpo.gc.ca> Date: 2019-06-05 02:21 (GMT-05:00) To: "Quinn, Caroline" < Caroline.Quinn@dfo-mpo.gc.ca>, "Fagan, Ashley" < Ashley.Fagan@dfo-mpo.gc.ca>, "Hubley, Marian" < Marian. Hubley@dfo-mpo.gc.ca>, "Girouard, Louise" < Louise. Girouard@dfo-mpo.gc.ca> Subject: Merci on PRV!! Salut! Just landed in Vancouver and wanted to send you a quick note to thank you on all your work on PRV, particularly over the past few days! The announcement landed very well, comment in the National Post: "This has been a six year battle and so it is very unexpected to see a fisheries minister take such a bold and unprecedented step," said in a statement. "However I know the devil lies in the detail and I am waiting to see who is going to do the testing and what is the protocol when they find the virus." https://nationalpost.com/pmn/news-pmn/canada-news-pmn/fisheries-minister-announces-wild-salmon-safeguardsand-aquaculture-virus-tests And the Minister got very positive comments from his MP colleagues and stakeholders. Please extend my thanks to everyone who worked on this! s.16(2)(c)Now on to the next! s.19(1)À demain,

Marie-Pascale Des Rosiers Director of Communications Office of the Minister of Fisheries, Oceans and the Canadian Coast Guard Cell:

M-P

From: Lowe, Carmel

Sent: June-05-19 11:15 AM

To: McPherson, Arran; Moore, Wayne; Parsons, Jay

Subject: Fwd: Question about your call with

Fyi

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "MacDougall, Lesley" < Lesley. MacDougall@dfo-mpo.gc.ca>

Date: 2019-06-05 2:06 PM (GMT-05:00)

To: "Reid, Rebecca" < Rebecca. Reid@dfo-mpo.gc.ca>

Cc: "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca>, "Webb, Allison" < Allison.Webb@dfo-mpo.gc.ca>

Subject: RE: Question about your call with

For your info: I'm on the AMD/ENGO call right now. Some points in regards to the discussion on the testing and screening.

- is asking how testing will *only* be testing for the Icelandic and Norwegian strains as she is unaware what method will be used to differentiate from the endemic
- But she is pleased to know we're doing the testing. DFO needs to prove that there is a BC strain.
- The language regarding what we are testing is not based in science as far as she is concerned. What type of virus and the full genetic sequencing.
- agree, want transparency in the testing methods, in the labs, and some 3rd party verification of the testing (perhaps a Norwegian lab), and want public reporting on the testing.
- Want to know what the virulence of PRV1 is in wild fish.
- And they want to know which labs are doing the work.
- To fill the knowledge gaps identified in the CSAS meeting this shouldn't be just about testing in the hatcheries there should also be efforts to test in the wild.

just said this is a huge step and is appreciative of DFO's progress.

From: MacDougall, Lesley Sent: June-05-19 10:31 AM

To: Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>Co: Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>Subject: RE: Question about your call with

Hi Rebecca - That question came up specifically. made it clear she is interested in getting the full genome sequencing of the BC variant, I made it clear that at this time, the intent is to test for Norwegian and Icelandic variants only.

Also noted that I wasn't sure where we were with full genotyping of the BC variant.

- I checked in with Stewart Johnson regarding a study of the genetic diversity and phylogenetic relationships between PRv1 from different hosts and geographic areas over time. They just

received earlier sequences from Norway, those analyses should be finished by next week, manuscript later this year.

Lesley

From: Reid, Rebecca < Rebecca. Reid@dfo-mpo.gc.ca >

Sent: June-05-19 10:24 AM

To: MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca >

Cc: Lowe, Carmel < Carmel. Lowe@dfo-mpo.gc.ca >

Subject: Question about your call with

Hi Lesley – quick question about your conversation yesterday with ______ On the issue of the PRV testing, do you think she understood that we were planning to test just the Norwegian and Icelandic strains only, and not across the board PRV testing? Her response was so positive, we were left wondering.

Appreciate any confirmation you could provide on the conversation.

Thanks.

RR

Rebecca Reid

Regional Director General/ Directrice générale régionale Fisheries and Oceans Canada - Pacific Region/ Pêches et Océans Canada - Région du Pacifique 200-401 Burrard Street / 401, rue Burrard, bureau 200

Vancouver, BC/CB V6C 3S4 Office / Téléphone: 604-666-6098

Cell / Cellulaire:

E-mail/ Courriel: rebecca.reid@dfo-mpo.gc.ca

s.16(2)(c)

s.19(1)

Dickie, Catherine		
From: Sent: To: Subject:	Lowe, Carmel June-05-19 11:30 AM Parsons, Jay; Moore, Wayne Fwd: FOR INPUT: MEDIA REQUEST - Aquaculture announcement - SeaWest News	
See below. I could do today?	with clarification on some of the issues below as I am sure could Lealey. Can we talk late	r
Sent from my Bell Samsur	ng device over Canada's largest network.	
Date: 2019-06-05 2:20 To: "Rainer, Michelle Cc: "Dickie, Catherine	" < Allison. Webb@dfo-mpo.gc.ca>	
Please send me yo finish you for the d	ur # and I can call you about this. Thxand will call when	1
Sent from my Blac	kBerry 10 smartphone on the Bell network.	
From: Webb, Allison Sent: Wednesday, June To: Rainer, Michelle; Lo Cc: Dickie, Catherine Subject: Re: FOR INPL		
Science NHQ alreatheir answers?	ady provided some responses. Can you check that you don't already have	
What is the deadlir	ne?	
Sent from my Blac	kBerry 10 smartphone on the Bell network.	
From: Rainer, Michelle Sent: Wednesday, June	e 5, 2019 2:53 PM	

To: Webb, Allison; Lowe, Carmel

Cc: Dickie, Catherine

Subject: FOR INPUT: MEDIA REQUEST - Aquaculture announcement - SeaWest News

Hi Allison and Carmel. Not sure who can answer the question below about costs. Do we have an estimate at this time?Thanks,

Michelle	s.19(1	I)

Reporter: , SeaWest News Deadline:

Issue: Tuesday's aquaculture announcement

- Does interim policy to test for foreign strains of the PRV virus as only for fish fairmers or for all hatcheries and all fin fish, including the 132 SEP licences to grow Pacific salmon for release, of which 18 are DFO operated hatcheries, 99 are community hatcheries and 15 are classroom facilities in BC.
- How do scientists test for PRV?
- Is the BC and foreign strains of PRV have a similar testing method?
- Is there a cost associated with the test?
- Do we have testing lab?

Does interim policy to test for foreign strains of the PRV virus is only for fish farmers or for all hatcheries and all fin fish, including the 132 SEP licences to grow Pacific salmon for release, of which 18 are DFO operated hatcheries, 99 are community hatcheries and 15 are classroom facilities in BC.

The survey for foreign strains is only for aquaculture hatcheries at this stage. However, the interim section 56 decision framework for movement of live fish will apply for all fish movements once consultations gave been undertaken.

How do scientists test for PRV? Is the BC and foreign strains of PRV have a similar testing method? Testing for all PRV strains can be done using known molecular testing techniques, including genetic sequencing or polymerase chain reaction (PCR) tests which reproduce small amounts of DNA in order to analyze the samples. DFO will collect samples and complete the analysis of the samples. [PACIFIC AMD TO CONFIRM]

Is there a cost associated with the test?

Yes [input needed from PACIFIC]

Do we have a testing lab?

Natalie Séguin

Senior Communications Advisor | Communications Branch Fisheries and Oceans Canada | Government of Canada Natalie.Seguin@dfo-mpo.gc.ca | NEW: Telephone: 613-949-1099

Conseillère principale en communications | Direction générale des communications Pêches et Océans Canada| Gouvernement du Canada

Natalie.Seguin@dfo-mpo.gc.ca | NOUVEAU: Téléphone: 613-949-1099

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@PechesOceansCAN et @FishOceansCAN

Follow us on Facebook: Fisheries and Oceans Canada | Suivez-nous sur Facebook: Pêches et Océans Canada

From:

Johal, Sharan

Sent:

June-06-19 8:36 AM

To:

Lowe, Carmel

Subject:

FW: PRV and the CSAS review process and public messaging by the DFO

FYI

Sharan Johal

Tel: 604-666-7102 / Fax: 604-666-8956

sharan.johal@dfo-mpo.gc.ca

From: McGill, Stephanie < Stephanie. McGill@dfo-mpo.gc.ca>

Sent: Thursday, June 6, 2019 8:24 AM

To: Hill, Johanna <Johanna.Hill@dfo-mpo.gc.ca>; Jarjour, Jasmine <Jasmine.Jarjour@dfo-mpo.gc.ca>

Cc: Johal, Sharan <Sharan.Johal@dfo-mpo.gc.ca>; Proctor, Jody <Jody.Proctor@dfo-mpo.gc.ca>;

Robinson, Connor < Connor. Robinson@dfo-mpo.gc.ca>

Subject: Re: PRV and the CSAS review process and public messaging by the DFO

Johanna.

Arran would be pleased to speak with Fiona to walk her through the e-mail/provide context. She had previously done this for Alexis. Over to you if you think this is something that could be scheduled.

Sent from my BlackBerry 10 smartphone on the Bell network.

From: McGill, Stephanie

Sent: Wednesday, June 5, 2019 16:29 **To:** Hill, Johanna; Jarjour, Jasmine

Cc: Johal, Sharan; Proctor, Jody; Robinson, Connor

Subject: RE: PRV and the CSAS review process and public messaging by the DFO

Will talk to Arran about it. Jay had previously flagged (he was on the initial e-mail), will find out what follow-up occurred (if anything, perhaps just an acknowledgment of receipt) and get back to you.

On Jun 5, 2019, at 4:24 PM, Jarjour, Jasmine < <u>Jasmine.Jarjour@dfo-mpo.gc.ca</u>> wrote:

Thinking this might be better as an EOS lead? Jaz

From: Hill, Johanna < Johanna. Hill@dfo-mpo.gc.ca>

Sent: June-05-19 3:59 PM

To: Johal, Sharan < Sharan. Johal @dfo-mpo.gc.ca >

Cc: Jarjour, Jasmine < Jasmine.Jarjour@dfo-mpo.gc.ca>; Proctor, Jody

<Jody.Proctor@dfo-mpo.gc.ca>

Subject: Fwd: PRV and the CSAS review process and public messaging by the DFO

Hi Sharan,

Can you please task a response as per Fiona's email to Rebecca? If you could route it back through DMO as per the usual process, I would appreciate it.

Thanks very much.

Johanna Hill

Begin forwarded message:

From: "Simons, Fiona" < Fiona. Simons@dfo-mpo.gc.ca>

Date: June 5, 2019 at 3:54:19 PM EDT

To: "Reid, Rebecca" < Rebecca.Reid@dfo-mpo.gc.ca> Cc: "Hill, Johanna" < Johanna.Hill@dfo-mpo.gc.ca>

Subject: FW: PRV and the CSAS review process and public messaging by the

DFO

Hi Rebecca – can you provide some more context for

comments

below?

Fiona Simons

Pacific Desk

Office of the Minister of Fisheries, Oceans, and the Canadian Coast Guard

T:

E: Fiona.Simons@dfo-mpo.gc.ca

From:

Sent: Friday, May 24, 2019 12:27 PM

To: Parsons, Jay; Olivier, Gilles; Craig Stephen

Cc: Jonathan.Wilkinson@parl.gc.ca

Subject: PRV and the CSAS review process and public messaging by the

DFO

Hi Jay/Gilles/Craig.

CC: The Honourable Jonathan Wilkinson, Minister, Fisheries and Oceans Canada

I have some concerns I would like to share concerning information being circulated publicly by DFO scientists about the presence/prevalence of PRV in Pacific waters and how this virus may be spread. This information was revealed at the recent Aquaculture Association of Canada's conference held in Victoria May 5-8, 2019.

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To the best of my knowledge, none of the information being shared publicly (by DFO scientists and/or scientists working with the DFO who presented at this conference) — and mentioned below — was made available to the experts who participated in the recent (January 29-31, 2019) CSAS PRV risk assessment. That gives me cause for concern.

At this conference it was asserted that (individual points follow below in bullet form):

Atlantic salmon hatcheries in B.C. are now free of PRV

I find this difficult to believe given that, during the PRV risk assessment held only a few months ago, we were presented with data that showed:

At line 270 in the risk assessment: "Between 2013 and 2018, PRV has been detected in hatcheries in all years..." Granted, the data showed a reduction in the percentage of positive fish over time, but it still showed that in every case, PRV was detected.

It was also noted that these were data made available to DFO <u>from</u> industry in January 2019.

There were no DFO test data provided/presented to support or challenge these findings. Nor were we advised that DFO had an active surveillance program in place to look for PRV in hatcheries. If anything, we were told there were no requirements in place for industry (or DFO) to test hatchery fish for PRV prior to transfer of fish to marine sites. Now, only three short months later, we have DFO scientists standing in front of an international audience telling them that all Atlantic salmon hatcheries in B.C. are PRV-free. How can that be?

It is my current understanding that DFO has not been testing hatcheries for this pathogen, so it would be helpful to know where are these new data come from. It is challenging to accept that the world of hatchery biosecurity can change so rapidly in just three months (since the close of the CSAS) when this pathogen (PRV) was prevalent in all Atlantic salmon hatcheries tested for the past five years.

 PRV (B.C.) came first to New Brunswick and from there to B.C. in about 1950-1960. It was suggested that attempts to plant Atlantics on the West Coast were the vector for transmission of the virus to B.C. (1905-1935).

It would seem this information has only come to light in the past three months. Not once was it mentioned in any of the working papers that were up for peer review during the CSAS process that this virus came to this coast from the East Coast of Canada (let alone that it came from New Brunswick) following attempts to establish Atlantic salmon here. This conclusion actually diverges from the published literature. On what credible evidence that was not available to the CSAS are DFO scientists now convinced this is the case?

 PRV levels are easily measured in the water. Samples have been taken. All near-farm samples tested positive for PRV @ at least 10.000 copies per litre.

As I recall, none of this information or data was included in any of the working papers presented to the CSAS peer-review panel. I find it hard

to believe that DFO has since mobilized crews to go to every salmoninformation. farm in B.C.; plan and conduct statistically significant sampling in the waters near those farms; and, have those samples gathered, processed and the data analyzed in just three months. Is that the case or is DFO somehow relying on data that should have been available to the CSAS?

Were any of these data in hand with the DFO prior to January 2019? If so, why were they excluded from any of the papers, commentary or analysis during the PRV risk assessment? As I recall, we were told that there were no data concerning concentrations of PRV particles in waters in or around farms — NONE. Therefore, assumptions, calculations and modelling similar to what was carried out for other pathogens in other risk-assessment scenarios could not be done for this pathogen (unlike during prior risk assessments for other pathogens — like Aeromonas salmonicida — wherein concentrations of viral particles outside of, and distant to, farms could be estimated and modelled using Mike Forman's particle dispersion models).

• 350 species have been checked to see if they might be a "reservoir species" for PRV, and they were all found to be clean. (Note: no species list was provided to back up this assertion.) This is highly improbable. A recent CSAS assessment was provided a list of ecological conservation priority species for MPA network design. It was included as an appendix in a CSAS report from June 2017 and includes fish, marine mammals, invertebrates, plants and algae. That list only mentions 142 species. It includes salmonids, flat fishes, forage fishes, rockfishes, ground fishes, sharks, pinnipeds and whales, among others.

I think it would be impossible to find, identify and sample 350 separate species and have them tested for PRV in just three months. There was no mention at any time during the CSAS review of any DFO surveillance or testing program where attempts were being made to find a "reservoir" species for this virus. I think it is reasonable to ask where this information came from. How long has the DFO had this information in hand? If they had any of this information prior to January 2019 (a logical conclusion would be that they did, at least in part), why was it not shared during the CSAS review?

It may be that what was transmitted to the public at this conference was wrongly interpreted. It may be that the actual assertion is that 350 "SAMPLES" have been taken in an attempt to identify a "reservoir species" and all of them were clean. However, even that would be a stretch. During the CSAS PRV review, we were presented with data showing testing in 10 Pacific fish species (salmon, trout and eulachon). All of them tested positive for PRV. However, none were alleged to be a "reservoir species." They were all identified as "fish species in which PRV genetic material was detected."

I question how any scientist can say then that all species (samples?) tested for PRV were "clean." Yet this is the message your scientists are sending to the world.

 They have benthic samples but haven't yet checked them out as a potential reservoir.

Again, there was no mention at any time during the CSAS review of any DFO surveillance or testing program where attempts were being made to find a "reservoir" for this virus. Surely this information, or at least the possibility that it was being gathered, would/should have been "known" prior to January 2019. But it was not even mentioned.

 The logical conclusion is that the wild fish have PRV and they're infecting the farmed salmon.

Apparently, this was an assertion made publicly at this conference by one of our fellow CSAS experts during one of the post-presentation question/discussion sessions. I don't recall that we ever reached that kind of conclusion during the CSAS review — not even close. Yet this is what is being reported to me as having been said by DFO in public forums.

 Tank and ocean pen experiments were conducted with Atlantic salmon at DFO's lab at Departure Bay (in West Vancouver) to see if the fish would contract the virus. Apparently, none of the fish became infected.

This seems entirely inconsistent with the assertion made above: that wild salmon are the main vector for transmission of the virus. The waters in and around Departure Bay are used by both juvenile and wild adult Pacific salmon almost year-round. If it were true that wild salmon are the key vector for transmission of the virus, the experimental fish would have become infected just as easily as the fish confined to fish farms. Again, none of these study results (or even the mention of such exposure trials) were mentioned during the CSAS review. Why is that?

I am sharing this with you and the minister because it troubles me, as a scientist who participated in the CSAS peer-review on the assessment of risk of exposure to wild Fraser River sockeye salmon from PRV on fish farms, that many of the unknowns and uncertainties that were identified in that review are now being portrayed publicly by DFO scientists as "known information." And I find it impossible to believe these large information gaps could have been filled in such a short time.

We are concerned as well that the minister may be getting incorrect, or questionable, information that he may use to guide DFO's evolving PRV policy, which is to be publicly announced in the near future. For that reason I have CC'd him on this email.

I would appreciate a reply from the CSAS to these concerns as they are, in our opinion, valid and need to be addressed.

I would also ask that you share this submission with the entire PRV review panel (Steering Committee and participants) so that they can share their opinions on these matters.

Regards David Suzuki Foundation

s.19(1)

From:

Sent: June-06-19 8:59 AM

To: McCorquodale, Brenda; Mollins, Jennifer; Adrienne.Paylor@dfo-mpo.gc; MacDougall, Lesley

Cc:

Subject: Materials requested

Attachments: A-2016-01101 Rimstad to Garver not convinced- .pdf; A-2016-01101 Rimstad redacted

results.pdf; Notes on PRV consultation for 'Namgis.docx; ATIP A2016-203 Gary Marty finds

HSMI in 2008.pdf

Hello All

Thank you for the meeting yesterday. Here is the information I promised to send.

Attached are two excerpts from an ATIP I received wherein Dr. Espen Rimstad expresses doubt about the results from Garver's sockeye infection trials. Also see that he reports to Garver that he is sending the results from a challenge experiment with PRV from BC sent to him by Garver's lab. Rimstad reports that the histopathologist graded the resulting lesions 1-3 and he recommends not using the energy to question whether or not PRV causes HSMI, as "we have firm evidence that this is not necessary."

As a result of these emails, I think it is critical to our understanding of PRV in BC to see the unredacted version of Espen Rimstad's April 4, 2016 email, the raw data from this work and all the findings by the Rimstad lab on PRV from BC. As I noted yesterday, Garver and Rimstad have not answered these questions.

Also attached are my notes on the PRV consultation deck sent to 'Namgis and my lawyers. I believe it is the same deck handed out yesterday, but if not identical page numbers, I hope that it can be deciphered without too much difficulty. My over-arching concerns are that DFO is:

- promising things that cannot be delivered, because the information on distribution of wild fish throughout the year is not known,
- that there is no mitigation to reduce virus release from marine net pen salmon farms
- That DFO is accepting there will be risk, but does not define this risk in biological terms. I don't think our state of knowledge supports any designation of risk levels under the precautionary principle
- That DFO no longer has "information on wild stock health and population status" as per the large reduction in enumeration effort, particularly if the contribution of small systems is considered important to area population health.

Finally, I attach an email that I think is important to all grappling with PRV in BC. It is a May 21, 2016 email from Dr. Gary Marty to Dr Emiliano Di Cicco revealing that he found HSMI lesions in 2008, took this information to the salmon farming industry and together they decided it was not HSMI. I understand Dr. Marty has his reasons for this as we have communicated on this point. However, I feel he should have revealed that the reason he decided with industry that it was not HSMI, was because he changed the accepted, published, international diagnosis for HSMI and he unfortunately did not present his reasons for doing this in the work that he has published (Marty et al 2014, Garver et al) which suggests that he did not find HSMI in BC. If a scientist is going to alter a diagnosis of a disease, this should be stated with reasons, when reporting on the disease. We know that using the accepted diagnosis Di Cicco et al (2017) did diagnose HSMI on the same cohort of fish from the same farm (Venture Pt) as Marty examined.

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	s.19(1)	

Sorry for the size of this email, I hope it has not caused problems in the downloading.

No further information has been removed or severed from this page

Garver, Kyle

From:

Espen Rimstad <espen.rimstad@nmbu.no>

Sent:

November-27-15 5:32 AM

To:

Polinski, Mark; Garver, Kyle; Øystein Wessel

Subject:

SV: Thanks for the call!

Hi Mark,

I am sorry for not responding earlier. It has been a busy week, and besides the material/graphs you send us were convincing. Yes, you have shown that the <u>Sckeys do get infected with PRV and stay infected</u>. But it is a subtle infection, that starts out rather slowly.

Something restricts the replication, it could be less suited receptors than Atlantics and it also should be the innate response. IFNs and their portifolio of hundreds of genes are present in all vertebrates - and respond to general things like dsRNA, phosphorylation in -ssRNAs etc,- this must be present in Sockeye as well. If I should be deliberately picky: Your cohab show infection after 4 w in Atlantics (as we do) the Sockeye is taking off at 4-6w. Are you sure that after ip injection you have an ongoing infection at the days you run the transcriptome testing? Could it not be diffusion or very early in virus infection from injected material that sticks to RBC, considering the timing of the cohab. As you see, I still have trouble to understand how the virus can replicate without the appearance of innate response from the cell.

Øystein had a paper on sigma 3 and binding to RNA a year ago, and Hanne from our lab will have a paper i Vet Res in January about formation of virus factories.

Good luck, I hope I didn't disencourage you from publishing this stuff.

best regards

Espen

Fra: Polinski, Mark < Mark. Polinski@dfo-mpo.gc.ca

Sendt: 16. november 2015 18:42

Til: Espen Rimstad; Garver, Kyle; Øystein Wessel

Emne: RE: Thanks for the call!

Hi Espen,

It was easier to address some of your comments by presenting a few graphs from our data, so my email response is attached in the form of a PDF document. Please let me know if you have any further questions or would like to discuss hypotheses/research possibilities further. I too find this dicotomy in PRV associated responses quite fascinating.

Mark

----Original Message----

From: Espen Rimstad [mailto:espen.rimstad@nmbu.no]

Sent: Fri 11/13/2015 2:02 AM To: Garver, Kyle; Øystein Wessel

Cc: Polinski, Mark

Subject: SV: Thanks for the call!

Dear Kyle and Mark,

000022

Mark (this is a friendly inquiry): I am not convinced your Sockeye got infected with PRV. If I remember correctly you injected PRV (RBC from Atlantics?) i.p., and then measured PRV Ct in blood in Sockeye. You found PRV Ct in blood, that fell, which is interpreted as increasing amount, and thus replication, of virus in the Sockeye. After some period of time the virus titer fell (i.e. Ct increased), so the virus titer had a bell shaped curve (?). You could not find any innate antiviral response in the Sockeye, and when exposing it to IHNV it was just as susceptible as non PRV challenged. Do I recall this correctly?

- 1. Without innate antiviral response it is logic that the Sockeye is susceptible to IHNV. So that finding is coherent with the lack of innate response.
- 2. Without innate antiviral response there will be nothing stopping PRV from replicating or spreading in the Sockeye. Why then did the virus titer in the Sockeye go down? If the Sockeye does not have any antiviral response, there is nothing stopping the virus from replicating, i.e. the titer should skyrocket, and not go down.
- 3. Assuming there is PRV replication and no innate antiviral response:
- a. This requires that there is no PAMPs in PRV that are recognized by Sockeye, no dsRNA (which is the strongest alarm signal known, if present in cytoplasm) exposed intracellularly etc, etc. PRV is a dsRNA virus, and although the capsid never really decomposes during the replication cycle, I can't see how it is possible not to trigger any TLRs or RIGs etc.
- b. It would require that PRV makes a super-efficient antiviral protein immediately after infection (but even that is too late to avoid trigging of the innate response), which PRV protein would that be?, and why doesn't it function similarly in Atlantics?
- c. I do not recall such example for any other horizontally transmitted virus?
- So I would rational that there is no, or very little, replication in Sockeye after i.p. injection of PRV.
- 5. How much PRV did you inject i.p., and how much did you find in the RBC fraction in blood? Was there a net increase in total amount of virus considering the amount of blood etc in the fish?
- 6. Due to the sticky surface of RBC viruses often sticks to RBC (that's why hemagglution tests can be used for many viruses) and the RBC may function as a vacuum cleaner to reduce the virus amount in fish (ISAV in Atlantics is a primary example). Could the i.p. injected PRV stick to the RBC surface (will then be measured as Ct in PCR) and because of slow diffusion from peritoneal cavity this may increase over time and be measured as an increase in virus titer (?)
- 7. My interpretation (or guess is more correctly) is that PRV probably sticks to Sockeye RBCs and has problems to get to the interior, for instance due to differences in receptor molecules between Atlantics and Sockeye.

Kind regards

Espen

Fra: Garver, Kyle [mailto:Kyle.Garver@dfo-mpo.gc.ca]

Sendt: 12. november 2015 18:56 Til: Espen Rimstad; Øystein Wessel

Kopi: Polinski, Mark Emne: Thanks for the call!

Garver, Kyle

From:

Espen Rimstad <espen.rimstad@nmbu.no>

Sent:

April-05-16 10:04 AM

To: Subject: Garver, Kyle SV: skype call

Fine, then we settle for April 12th.

Espen

Fra: Garver, Kyle < Kyle. Garver@dfo-mpo.gc.ca>

Sendt: 5. april 2016 00:43:19

Til: Espen Rimstad Kopi: Øystein Wessel Emne: RE: skype call

Hi Espen,

Very exciting to hear of the BC challenge. We (Mark and I) could skype with you April 12th or 13th at 7AM Pacific time (4 PM Olso time). Alternatively we could call during our evening time (10 PM Pacific) which would be 7 AM your time.

Looking forward to speaking with you soon..

Kyle

s.20(1)(b)

s.21(1)(a) s.21(1)(b)

From: Espen Rimstad [mailto:espen.rimstad@nmbu.no]

Sent: April-04-16 8:45 AM

To: Garver, Kyle Cc: Øystein Wessel Subject: SV: skype call

HI Kyle,

Last Friday we had a Skype meeting with Emiliano et co. Are you aware of their findings? Oestein and myself feel a bit in a Catch 22 posititon.

But we would like to inform you about the first outcome of the experimental challenge with the BC isolate you send us. We will organise a file with details later.

The histopat is done by someone outside our department, and they grade it fotr us (1-3). I would not recommend to use energy about the question if PRV causes HSMI or not (i.e. if you need additional factors or not) we have firm evidence that this is not necessary.

000039

Regards, Espen

Fra: Garver, Kyle < Kyle.Garver@dfo-mpo.gc.ca >

Sendt: 29. mars 2016 12:55

Til: Espen Rimstad

Emne: Out of Office AutoReply: skype call

I'm out of the office until April 4, 2016 and have limited access to email.

Regards, Kyle

Kyle Garver, Ph.D.

Fisheries and Oceans Canada

Pacific Biological Station

Aquatic Animal Health

3190 Hammond Bay Road Nanaimo, BC V9T 6N7

Phone:(250)756-7340 Fax: (250) 756-7053

email: Kyle.Garver@dfo-mpo.gc.ca

Notes on PRV consultation for 'Namgis

The Framework for Aquaculture Risk Management does not list protection of wild salmon among its "Objectives"

Page 7 - Important considerations include when, where, and for how long a source at each of the susceptible wild fish will be in the vicinity of the fish being moved, the date of the movement, the incubation period of the infectious disease agent, and the disease dynamics in the susceptible fish." DFO has done so little research on the movements of wild fish that none of these things are known for a given area around a farm, especially given they use the term "fish" which includes herring, halibut, oolichans and many other species.

Page 8 Assessments are then classified reflecting the Department's risk tolerance. This classification is linked to the relative conservation status of wild fish aggregates which may come into contact with the transferred fish." I interpret this to say that fish aggregates that are healthy can be subjected to greater risk... until they are as low as the other stocks? It's as if low stocks is the goal

Page 8 - Wisk may be lowered through the application of mitigation measure; which are considered as part of the risk management process." Mitigation is not part of s. 56 and I can't think of any work that shows one can mitigate the impact of farm salmon shedding PRV into wild fish habitat.

I don't see how any of page 9 is part of s. 56

Page 10 - The magnitude and severity of any potential consequences of the authorization of a transfer of live fish, and the likelihood of those impacts are plotted on risk matrices. This allows for a scientific assessment of risk." Far too little is known about how PRV affects wild fish, including species other than salmon, to conduct any of "scientific assessment" at even a low level of confidence. Also on this page — to even consider exposing healthy populations to a risk that so little is known about is negligent, does not meet public expectation.

Page 11 - Regarding "ow" "medium" "high" is the first question is risk to what? Wild salmon, herring, oolichans? Second, as above the paucity of research on the impact of PRV on fish in the wild environment is close to 100%. We know a little about infection related to exposure and the Chinook Master's Thesis is concerning, but beyond that almost nothing is known. There is no defensible way to make these

ratings, what can they possibly be thinking? It's as if they haven't noticed other research teams are looking at this situation too.

Page 12 - " oformation on wild stock health and population status DFO has withdrawn from stock assessment in the Broughton which means they don't have information on wild stocks.

Page 12 - Does s. 56 actually consider " ocial and economic impacts that would result from the proposed transfer"?

Page 14 - CSAS – . not only called foul on the CSAS "consensus" that PRV is low risk to Fraser sockeye and who took notes on at the recent Aquaculture Association of Canada, AAC, meeting she attended, and suggests there is substantive information that was not made available to the CSAS. Also absent from the material reviewed is a Dec 2018 Masters Thesis on PRV infection in juvenile Chinook infection and evidence of disease correlated with farm exposure – granted they are not not sockeye, but this work is applicable within the context of the PRV Policy.

Page 14 omits the findings of Morton et al (2017) reporting significantly higher PRV infection in wild salmon exposed to salmon farms and the Master's Thesis finding that PRV infection in wild juvenile Chinook is higher near salmon farms

Page 15 - BC PRV-1 has less genetic variability and less virulence for Atlant Valmon than Norwegian PRV-1" – this needs a citation. Notably, low genetic variability is a characteristic of a virus subjected to a tight genetic bottleneck, such as introduction into novel habitat, where only a very small subgroup of a larger infected population arrive in a new place. So this funding supports recent introduction of PRV to BC as per Kibenge et al (2013, 2017).

Page 15 " However, it was not predictive of development of disease." If they want to refute all the science reporting that PRV causes disease they need to explain the errors in all the papers that report PRV causes disease (Palacious, Finstad, Wessel, Di Cicco etc)

Page 15 "Sockeye Salmon appear less susceptible to infection relative to Atlant Salmon in British Columbia following experimental exposure" Espen Rimstad argued this point with Garver. We don't know how that argument was resolved. Garver and Rimstad won't say, they removed their ongoing correspondence from

the DFO server and Rimstad's challenge work with PRV provided by Garver has not been made public to my knowledge.

Page 15 - In marine net-pens PRV-1 has been associated with severe heart inflammation in farmed Atlantic Salmon and jaundice/anemia syndrome in farmed himook Salmon in British Columbia: but a causal relationship has not been established. Wessel et al (2017) did establish a causal relationship between PRV and HSMI in Atlantic salmon in the paper titled: Infection with purified Piscine orthoreovirus demonstrates a causal relationship with heart and skeletal muscle inflammation in Atlantic salmon

Page 16 - If the precautionary principle was in effect, Bullet 1 would be all that is required to classify PRV as a "disease agent" subject to screening and prohibitions as per s. 56 FGR. Yes, it causes the same disease here as reported in Norway, where PRV has been shown to be the cause of HSMI and there is now strong evidence that it is also causing disease in Pacific salmon.

Bullet 2 - seems irrelevant if bullet 1 is true. PRV *is* causing the same disease in BC farms as Norwegian farms, where PRV has been shown to be the cause. If DFO can't make this happen in the lab, perhaps they have a methods design flaw as suggested by Rimstad.

Bullet 3 – if they can't make PRV cause disease in Atlantic salmon in a lab, when it *is* occurring in farms, then perhaps it is not surprising they can't cause it in sockeye either.

Bullet 4 – "No impairment of resouratory function has been demonstrate" I will need to see further work on this issue. If a cell is filled with a virus to the bursting point, it is difficult to understand how that cell has the same capacity to carry oxygen as it did when it was not on a trajectory to a ruptured cell wall. However, respiratory impact is not the bar for determining whether PRV is a disease agent or not.

Bullet – 5 – "current evidence does not support the conclusion that BC PRV-1 causes disease or mortality in Sockeve Salmor". This may be true, but DFO has not used all the tools in their toolbox. Are these fish exhibiting a viral disease immune response (VDD)? However, application of s.56 does not require proof that PRV is a disease agent in sockeye in a tank. Di Cicco et al (2017) already established this.

Page 19 - Disease agent: An infectious agent that causes or contributes to the levelopment of a disease. It seems important that "contributes to" is in this statement as that is a lower standard and may require a secondary factor such as stress, which is likely lower in a lab than in the wild.

No information has been removed or severed from this page

-----Original Message-----From: DiCicco, Emiliano Sent: Sat 5/21/2016 9:00 PM To: Miller-Saunders, Kristi Subject: I: HSMI diagnoses in BC

Hi... look at the following...

Hook forward to reading Hugh's reply, though...

Talk you soon,

Emiliano

Emiliano Di Cicco DVM PhD

Fish Health Researcher

Molecular Genetics Lab - Pacific Biological Station Department of Fisheries and Oceans, Canada 3190 Hammond Bay Rd, Nanaimo, BC V9T 1K6 - Canada Phone: office (250) 756 7045

Cell

e-mail: Emiliano.DiCicco@dfo-mpo.gc.ca

s.19(1) s.21(1)(a)

s.21(1)(b)

-----Messaggio originale-----

Da: Marty, Gary D AGRI:EX [mailto:Gary.Marty@gov.bc.ca]

Inviato: sab 21/05/2016 12.36

A: DiCicco, Emiliano; 'ferguson@fishpathology.com'

Oggetto: HSMI diagnoses in BC

Hi Hugh and Emiliano,

It was nice to see you at the meeting on Wednesday. I appreciate that conflict is a part of science. In this case, some additional information might help clarify some things.

In particular, I want to clarify how HSMI has been defined in BC since I began working in my current position in 2004. It was not long after I started that I began seeing occasional fish with epicarditis, endocarditis, and variable amounts of myocardial necrosis. When I first diagnosed those cases, I provided a general comment that these lesions were

consistent with systemic disease. In February 2008, provided BC vets a continuing education session that summarized the pathology of emerging European diseases in farmed Atlantic salmon. When she showed images of HSMI, I immediately recognized the lesions as similar to what I had been seeing microscopically in some BC fish. However, the aquaculture veterinarians said that they were not seeing a clinical pattern that was consistent with Norwegian HSMI (all the Atlantic salmon companies have Norwegian connections, so I assume that they are well aware of the clinical signs of HSMI). Therefore, we decided that what I was seeing was probably not the same as Norwegian HSMI. We understood HSMI to be the name of a disease syndrome, and that characteristic clinical signs were needed for a diagnosis of HSMI (i.e., similar morphologic lesions without clinical signs did not warrant a diagnosis of HSMI). After that session, when I saw inflammatory heart lesions that were similar to HSMI, I started adding to my comments a note that the lesions were similar to lesions in Norwegian fish with HSMI, but that HSMI had never been seen in BC.

The expert report that I produced in an ongoing Canadian legal case provides a good example:

Public reporting: Affidavit of Dr. Gary D. Marty sworn October 30, 2013, in Morton v. Minister of Fisheries and Oceans et al, Federal Court No. T-789-13

21. Have you tested fish for PRV and/or HSMI with results that contradict the results of your testing for MHC?

I have not tested fish for PRV and/or HSMI with results that contradict the results of my testing for MHC, but I have tested fish in which the suite of lesions was different than the groups of fish I examined from MHC or DFO.

As described in my answer to question #4, among all the testing I have done for HSMI (e.g., the BC Fish Health Auditing and Surveillance Program), I occasionally diagnose "unexplained heart lesions" as the cause of death. However, the prevalence of PRV in tested cases (80%) is the same as the prevalence of PRV among (i) groups of fish that die of other causes and (ii) healthy fish that are sampled for pretransfer screening.

In two cases submitted directly by a BC fish farm company other than Marine Harvest (one case in 2011 and one case from a different farm in 2013), I diagnosed unexplained heart lesions as the cause of death in all of the fish in the sample group. These cases were not tested for PRV, but based on other data there is an 80% chance that they would be PRV positive. In this year's case, I requested a second submission that included skeletal muscle for histopathology (skeletal muscle is not included in routine submissions for diagnostic purposes). One of the 10 fish included in the second submission had severe heart lesions but no skeletal muscle inflammation; therefore, this fish did not have HSMI. Three other fish had moderate to severe heart lesions along with mild inflammation of skeletal muscle; therefore, these fish had inflammation of the heart and skeletal muscle, which are two features of HSMI. However, the farm's veterinarian told me that the fish did not have clinical signs consistent with the description of the European syndrome HSMI (see Dr. Nylund's expert report, answer to his question 24). Because these BC fish did not have all features of the European syndrome HSMI (i.e., clinical features are different), it is not appropriate to diagnose HSMI in these fish. Without consistent clinical signs, a diagnosis of HSMI in these fish is likely to result another example of the diagnostic "confusion" described by Dr. Nylund in his expert report (i.e., the response to his question 22). The submission form submitted with the second BC sample included a history that stated, "As environmental conditions improved, mortality

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dropped significantly. Mortality is now low normal with no clinical signs of disease." The cause of the heart lesions in these fish remains unknown, but all the information I have better fits "transient adverse environmental conditions" (e.g., exposure to algal toxins) as the cause of disease rather than PRV. Also, if BC strains of PRV were causing HSMI, it is not plausible to have 80% of BC Atlantic salmon infected with PRV every year since 2006, but have only two cases of HSMI during that same period.

This expert report was entered into evidence and is available to the public. In the 2.5 years since I produced this document, I have not seen any information that compels me to change my response to this question (# 21). After our meeting on Wednesday,

I think that the information above supports the conclusion that I diagnose inflammation in the heart and skeletal muscle when it occurs; however, I do not diagnose HSMI in these fish because the submitting veterinarians tell me that their fish do not have clinical signs consistent with HSMI. As a referral veterinarian, I would need some very strong justification to diagnose a syndrome contrary to the information provided by my referring veterinarians.

To summarize, I provided information in a public document 2.5 years ago that stated, "these fish had inflammation of the heart and skeletal muscle, which are two features of HSMI". My understanding from our meeting on Wednesday is that we do not disagree on these two features of HSMI. My understanding is that the fish I examined and the fish you examined were from the same farm and from the same outbreak. I reported "inflammation of the heart and skeletal muscle" publicly in 2013. Your findings of the same lesions from the same outbreak were reported yesterday (2.5 years later).

"A feared viral disease proven deadly in Norwegian fish farms has been confirmed for the first time by federal scientists studying farmed salmon in B.C.

Heart and Skeletal Muscle Inflammation (HSMI) has been linked to the deaths of up to 20 per cent at some Norwegian farms.

'The concern is that it is a disease that hasn't previously been detected in B.C. and at the present time we really don't have sufficient evidence to know if it causes mortality or is a production issue here,' said Kristi Miller, part of a team of federal scientists studying farmed fish samples from sites along the B.C. coast."

http://www.cbc.ca/news/canada/british-columbia/farmed-salmon-bc-disease-hsmi-aquaculture-1.3593958

s.19(1)

Best regards,

s.20(1)(b)

Gary

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P.S. In my experience, reporters will make changes to stories if errors are pointed out quickly. I recognize that the information I highlight from the CBC story was not included in the press release, and that it might have been influenced by discussions with other people (e.g.,

Gary D. Marty, D.V.M., Ph.D., Diplomate, A.C.V.P.

Senior Fish Pathologist Animal Health Centre Ministry of Agriculture 1767 Angus Campbell Rd. Abbotsford, BC, V3G 2M3 604-556-3123

From:

Higgins, Mark

Sent:

June-10-19 8:49 AM

To:

Miller-Saunders, Kristi; MacDougall, Lesley

Cc:

Lowe, Carmel: Moore, Wayne: Parsons, Jav

Subject:

RE: summary - today's discussion

Hi Lesley, Yes, thanks for the recap. I have also added a few clarifications into the text in green. Mark.

From: Miller-Saunders, Kristi < Kristi.Saunders@dfo-mpo.gc.ca>

Sent: June-07-19 5:00 PM

To: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Higgins, Mark <Mark.Higgins@dfo-

mpo.gc.ca>

Cc: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca>;

Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>
Subject: RE: summary - today's discussion

Good synopsis Lesley. See my additional comments below

Kristi Miller-Saunders, PhD

Head, Molecular Genetics
Pacific Biological Station
3190 Hammond Bay Rd
Nanaimo BC V9T 6N7
250-756-7155

Kristi.Saunders@dfo-mpo.gc.ca

From: MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca >

Sent: June-07-19 3:45 PM

To: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca>; Miller-Saunders, Kristi < Kristi. Saunders@dfo-

mpo.gc.ca>

Cc: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca >; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca >;

Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Subject: summary - today's discussion

Hi Mark and Kristi:

First, thank you both for your openness, willingness to work through this and, as always, your expertise.

1

Page 627 is withheld pursuant to sections est retenue en vertu des articles

21(1)(b), 21(1)(a)

of the Access to Information Act de la Loi sur l'accès à l'information

AVAILABILITY NEXT WEEK:

Kristi – will be in Tofino Monday and Tuesday. May be able to join a call on Tuesday

Mark – has the SCC assessment of the Aquatic Animal Health lab against the ISO 12025 standard from Tuesday until Thursday at noon

Lesley – will be in transit Wednesday afternoon, then could participate in a call from Ottawa (assuming someone will vouch for me if I turn up at NHQ), except for a few hours Thursday afternoon.

Lesley MacDougall

A/Division Manager, Aquatic Diagnostics, Genomics & Technology / Division des diagnostics, la génomique, de la technologie aquatique Fisheries and Oceans Canada / Péches et Océans Canada Pacific Biological Station / Station Biologique du Pacifique Nanaimo, B.C. V9T 6N7 250-756-7895

Lesley.MacDougall@dfo-mpo.gc.ca

s.21(1)(a)

s.21(1)(b)

From:

Higgins, Mark

Sent:

June-10-19 1:14 PM

To:

MacDougall, Lesley; Miller-Saunders, Kristi

Cc:

Lowe, Carmel; Moore, Wayne; Parsons, Jay

Subject:

RE: summary - today's discussion

I just wanted to clarify as well, from the ministers announcement, it sounded to me that determination of HSMI/Jaundice in aquaculture stocks would be the responsibility of the industry, so DFO may not have any part of this testing, nor input into who would conducts the analysis. For the purposes of the meeting we had on Friday, we talked about 'what if' this portion of the testing came to DFO for analysis, so it was really more a speculative exercise. Mark.

From: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Sent: June-07-19 3:45 PM

To: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca>; Miller-Saunders, Kristi < Kristi. Saunders@dfo-

mpo.gc.ca>

Cc: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca>;

Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Subject: summary - today's discussion

Hi Mark and Kristi;

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Lesley MacDougall

A/Division Manager, Aquatic Diagnostics, Genomics & Technology / Division des diagnostics, la génomique, de la technologie aquatique Fisheries and Oceans Canada / Péches et Océans Canada

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Nanaimo, B.C. V9T 6N7

250-756-7395

Lesley, MacDougali@dio-mpo.gc.ca

s.21(1)(a)

s.21(1)(b)

From: McPherson, Arran
Sent: June-12-19 1:10 PM

To: Morel, Philippe; Dostal, Alexandra; Reid, Rebecca; Lowe, Carmel

Cc: Jarjour, Jasmine; Proctor, Jody; Robinson, Connor; Parsons, Jay; Moore, Wayne; McGill,

Stephanie

Subject: PRV

Attachments: CSAS_RES_2019_036_Risk_Assessment_PRV.pdf; CSAS_RES_2019_035

_PRV_Characterization.pdf

Hi everyone, enclosed are copies of the CSAS Research Documents that we are in the process of finalizing for posting. They are not to be circulated further at this time. However, they have been shared with Communications to assist with the development of any reactive materials. They will also be provided to MINO, pre-lease. Arran.



Fisheries and Oceans

Canada

Pêches et Océans

Canada

Ecosystems and Oceans Science

Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2019/036 National Capital Region

Available at http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2019/2019_036-eng.pdf

Assessment of the risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) transfer from Atlantic Salmon farms in the Discovery Islands area, British Columbia

C. Mimeault¹, M. Polinski², K.A. Garver², S.R.M. Jones², S. Johnson², F. Boily¹, G. Malcolm¹, K. Holt³, I.J. Burgetz¹, and G.J. Parsons¹

¹Fisheries and Oceans Canada Aquaculture, Biotechnology and Aquatic Animal Health Science 200 Kent, Ottawa, ON K1A 0E6

²Fisheries and Oceans Canada Pacific Biological Station 3190 Hammond Bay Road, Nanaimo, BC V9T 6N7

³Fisheries and Oceans Canada Institute of Ocean Sciences 9860 West Saanich Road, Sidney, BC V8L 5T5



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68(a)

of the Access to Information Act de la Loi sur l'accès à l'information

Fisheries and Oceans Canada Pêches et Océans Canada

Ecosystems and Oceans Science

Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2019/035
National Capital Region and Pacific Region

Available at http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2019/2019_035-eng.pdf

Characterization of piscine orthoreovirus (PRV) and associated diseases to inform pathogen transfer risk assessments in British Columbia

Mark Polinski and Kyle Garver

Fisheries and Oceans Canada Pacific Biological Station 3190 Hammond Bay Road Nanaimo, British Columbia, V9T 6N7





Pages 686 to / à 723 are withheld pursuant to section sont retenues en vertu de l'article

68(a)

of the Access to Information Act de la Loi sur l'accès à l'information

From Connor:

From:	McPherson, Arran June-12-19 4:37 PM
Sent: To:	Lowe, Carmel
Subject:	FW: Sea Lice Table for DM tonight
Attachments:	Sea Lice Table.docx
Rebecca was leading this and send From: Dostal, Alexandra Sent: Wednesday, June 12, 2019 5	rew; Webb, Allison; McPherson, Arran; Parsons, Jay; Lowe, Carmel; Fagan, Ashley; Morel, bell, John P.
Hello colleagues,	
as discussed, Pacific has agreed to	on PRV and on sea lice. Later this evening I'll send around some PRV next steps. On sea lice, take a stab at the table that the DM is looking for tonight and to send it to him tonight. I ful, and I think science will need to input as well.
	ay, I tried to make a template for the table -1 might have it wrong so Pacific colleagues, see fit before sending up to the DM.
For guidance, below is the origina that gives a flavor of what is being	I template I had prepped and sent to Connor and Jody, and their replies are below, in case contemplated.
-	ear you tomorrow – Pacific, when it goes if you don't mind copying in us and science that see same doc as the DM for tomorrow.
Cheers,	
alix	
From Jody:	
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Hey Alix, I think those are the right questions the DM needs to be able to speak to tomorrow at the Min briefing. I think the framing the DM wants to be able to give is 1) here are the concerns we've heard from stakeholders, 2) what do we think about those concerns and what does our science say; and 3) if we are going to propose enhancements what are the management actions we would consider in the short term and those we'd like to do more work/consult on over the longer term to be in position to change COL in time for the next outmigration window.
I think your table covers that. If you could pre-populate that with what we had in the note and that annex I think that would be a good start. We would need to get this table to Tim at some point this evening in hopes he'll be comfortable briefing verbally tomorrow morning.
Original template I sent:

Stakeholder Views (suggestions on actions)

Departmental Response to Stakeholder View

Science Advice (what is risk to salmon of sea lice)

What is ongoing science work on sea lice in department
What management actions are we considering and timing (COL etc)
What we could announce now
What we could almounce now
Alix Dostal
Director General, Aquaculture Management Directorate Directrice générale, Direction de la gestion de l'aquaculture Aquaculture Management Directorate Direction de la gestion de l'aquaculture Telephone Téléphone: 613-993-1884 Alexandra.Dostal@dfo-mpo.gc.ca <mailto:alexandra.dostal@dfo-mpo.gc.ca> Government of Canada Gouvernement du Canada</mailto:alexandra.dostal@dfo-mpo.gc.ca>

Alix Dostal
Director General, Aquaculture Management Directorate Directrice générale, Direction de la gestion de l'aquaculture Aquaculture Management Directorate Direction de la gestion de l'aquaculture Telephone Téléphone: 613-993-1884 Alexandra.Dostal@dfo-mpo.gc.ca <mailto:alexandra.dostal@dfo-mpo.gc.ca> Government of Canada Gouvernement du Canada</mailto:alexandra.dostal@dfo-mpo.gc.ca>
No information has been removed or severed from this page

SEA LICE

June 12, 2019

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From:	
Sent:	

Dostal, Alexandra June-12-19 5:24 PM

To:

Lowe, Carmel

Subject:

Fwd: Sea Lice Table for DM tonight

Attachments:

Sea Lice Table.docx; ATT00001.htm

I am so sorry!! I was moving too quickly. Sent from my iPhone

Begin forwarded message:

From: "Dostal, Alexandra" < Alexandra. Dostal@dfo-mpo.gc.ca >

Date: June 12, 2019 at 5:21:17 PM EDT

To: "Reid, Rebecca" < Rebecca. Reid@dfo-mpo.gc.ca>, "Thomson, Andrew"

< Andrew. Thomson@dfo-mpo.gc.ca >, "Webb, Allison" < Allison. Webb@dfo-mpo.gc.ca >,

"McPherson, Arran" < Arran. McPherson@dfo-mpo.gc.ca>, "Parsons, Jay"

<a href="mailto:specific representations of the content of the con

Ashley" <<u>Ashley.Fagan@dfo-mpo.gc.ca</u>>, "Morel, Philippe" <<u>Philippe.Morel@dfo-mpo.gc.ca</u>>, "Struthers, Alistair" <Alistair.Struthers@dfo-mpo.gc.ca>, "Campbell, John

P." <John.Campbell@dfo-mpo.gc.ca>

Cc: "Dostal, Alexandra" < Alexandra. Dostal@dfo-mpo.gc.ca>

Subject: Sea Lice Table for DM tonight

Hello colleagues,

Thanks so much for the call today on PRV and on sea lice. Later this evening I'll send around some PRV next steps. On sea lice, as discussed, Pacific has agreed to take a stab at the table that the DM is looking for tonight and to send it to him tonight. I am happy to look at a draft if helpful, and I think science will need to input as well.

Based on conversations from today, I tried to make a template for the table – I might have it wrong so Pacific colleagues, please feel free to adjust as you see fit before sending up to the DM.

For guidance, below is the original template I had prepped and sent to Connor and Jody, and their replies are below, in case that gives a flavor of what is being contemplated.

Thanks again so much and I will hear you tomorrow – Pacific, when it goes if you don't mind copying in us and science that would be great so that we have the same doc as the DM for tomorrow.

Cheers.

alix

From Jody:

Hi – can we make sure we differentiate between new and existing management actions? As well, in addition to the "what we can announce now" piece, we should include

what we need to further understand, what we need to consult on and what we think we should not do (when/if applicable). I don't know if we need a "departmental response to stakeholder views" – that should get picked up in what follows. On the science piece, I think just some backpocket points on what the science tells us on how big this problem really is. The ongoing work may be more detail than we need at this point (although Arran should be ready to speak to it). I would then use the columns below to identify any work we would do to address gaps in the science, to the extent they exist.

From Connor:

Hey Alix,

I think those are the right questions the DM needs to be able to speak to tomorrow at the Min briefing. I think the framing the DM wants to be able to give is 1) here are the concerns we've heard from stakeholders, 2) what do we think about those concerns and what does our science say; and 3) if we are going to propose enhancements what are the management actions we would consider in the short term and those we'd like to do more work/consult on over the longer term to be in position to change COL in time for the next outmigration window.

I think your table covers that. If you could pre-populate that with what we had in the note and that annex I think that would be a good start. We would need to get this table to Tim at some point this evening in hopes he'll be comfortable briefing verbally tomorrow morning.

Original template I sent:

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on actions)		 		· · · · · · · · · · · · · · · · · · ·	
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could					

announce			
now			

Alix Dostal

Director General, Aquaculture Management Directorate | Directrice générale, Direction de la gestion de l'aquaculture

Aquaculture Management Directorate | Direction de la gestion de l'aquaculture

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Government of Canada | Gouvernement du Canada

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Page 732
is a duplicate of
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page 728

From:

Medeiros, Dean

Sent:

June-13-19 5:40 PM

To:

Paylor, Adrienne; Webb, Allison; Lowe, Carmel; Burgetz, Ingrid; Parsons, Jay; MacDougall,

Lesley; Higgins, Mark; Ang, Melanie; McConnachie, Sarah

Subject:

Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1

Attachments:

PRV Survey of Aquaculture Hatcheries.docx

Hi everyone,

Attached are some questions that Jay prepared to facilitate tomorrow's discussion - thanks Jay!

À demain!

Dean

Organizer: Medeiros, Dean

When: 11:00 AM - 12:00 PM 14 juin 2019

Subject: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1

Location: 10N196

Sent from my BlackBerry 10 smartphone on the Bell network.

PRV Survey of Aquaculture Hatcheries

Points of discussion:

List of aquaculture hatcheries:

- 1. AMD to provide list.
- 2. Clarify how many 12 or more?
- 3. Does this include just Atlantic Salmon or also Chinook?

Sampling frequency:

- 1.
- 2. One or two year survey?

Approach to PRV testing of samples:

Who should do the testing?

- 1. DFO Science
- 2. External
 - a. Who (CAHS?)
- 3. DFO with some external "validation"

[Science] Sampling protocol:

- 1. How many fish?
- 2. What sample processing is required?

[Science] PRV testing protocol

- 1. PCR?
- 2. Mutiplex PCR?
- 3. Sequencing?
- a. S1 or full sequence?
- 4. Pooled samples PCR, followed by sequencing for positives?

Costs

- 1. Hatchery sampling
- 2. Internal PRV analysis
- 3. External PRV analysis

HSMI / Jaundice

- 1. Industry to sample and source testing?
- 2. Science advice needed (sampling? Testing? Definitions)?

s.21(1)(a)

s.21(1)(b)

From:

Webb. Allison

Sent:

June-13-19 7:01 PM

To:

Johal, Sharan; Thomson, Andrew; Lowe, Carmel; McCorquodale, Brenda

Cc:

Barton, Meagan; Dickie, Catherine; Delaney, Paula

Subject:

RE: MINO: Key PRV Papers - Timeline for PRV Fish Health Impairment Potential

I'm sorry for not responding earlier. I am uncertain as to whether or not I have seen this before.

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: Johal, Sharan <Sharan.Johal@dfo-mpo.gc.ca>

Sent: Tuesday, June 11, 2019 12:41 PM

To: Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca>; Webb, Allison < Allison. Webb@dfo-

mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; McCorquodale, Brenda

<Brenda.McCorquodale@dfo-mpo.qc.ca>

Cc: Barton, Meagan < Meagan.Barton@dfo-mpo.gc.ca>; Dickie, Catherine < Catherine.Dickie@dfo-

mpo.gc.ca>; Delaney, Paula <Paula.Delaney@dfo-mpo.gc.ca>

Subject: MINO: Key PRV Papers - Timeline for PRV Fish Health Impairment Potential

Good afternoon all, have any of you received the attached before (the Minister has asked).

Thank you

Sharan Johal

A/Team Lead, Executive Secretariat

Regional Director General's Office/Bureau Directeur Général Regional

Fisheries and Oceans Canada - Pacific Region/ Pêches et Océans Canada - Région du Pacifique 200-401 Burrard Street / 401, rue Burrard, bureau 200

Vancouver, BC/CB V6C 3S4

Tel: 604-666-7102 / Fax: 604-666-8956

sharan.johal@dfo-mpo.gc.ca

s.21(1)(a)

s.21(1)(b)

Timeline for PRV Fish Health Impairment Potential*

- **2004** Kongtorp *et al.* (a¹,b²): First case definition of HSMI and demonstration that it is infectious.
- **2006** Watanabe et al.³: Early evidence on potential viral cause of HSMI.
- 2009 Kongtorp and Taksdal⁴: Risks of spreading HSMI by transferring apparently healthy fish.
- 2010 Palacios et al.5: PRV discovered reported as viral precursor of HSMI.
- 2012 Finstad et al.6: Further evidence that PRV causes HSMI.

Løvoll *et al.*⁷: Elevated PRV loads associated with presence of HSMI. No evidence of differences in virulence between PRV strains.

Kristoffersen et al.8: Risk of long-distance dispersal of PRV over 50-100 km.

Garseth *et al.* (a⁹, b¹⁰, c¹¹): PRV widely dispersed (without HSMI) in wild Atlantic salmon, can spread from farm to wild salmon, sea-trout could play role in pathogen exchange with wild Atlantic salmon.

- **2013** Kibenge *et al.* ¹²: BC PRV sequences closely related to a Norwegian sub-genotype.
- **2014** Finstad *et al.*¹³: Discovery that PRV first proliferates in red blood cells with potential effects on fish health.

Miller et al. 14: Shortened survival for PRV-infected sockeye salmon returning to Chilko Lake.

Marty et al. 15: Heart lesions in BC not likely caused by PRV. PRV may not cause HSMI.

2015 Wessel et al. 16: Technical progress on molecular-level functioning of PRV.

Wessel et al.¹⁷: More definitive evidence that PRV can replicate in red blood cells.

Olsen et al.¹⁸: HSMI-like disease and anemia along with PRV-like virus in rainbow trout.

Dahle *et al.*¹⁹: Found major phenotypic changes in PRV-infected red blood cells in Atlantic salmon. Functional consequences unexplored.

Bjørgen et al.²⁰: Elevated PRV levels in damaged versus undamaged muscle cells. Further evidence that PRV causes HSMI.

DFO²¹: PRV in BC farmed and wild salmonids. No reports of HSMI in BC.

2016 Siah et al.^{22,23}: HSMI not in BC. PRV widespread, long-present in BC.

Madhun et al.²⁴: Low prevalence and intensity of PRV in wild sea trout.

Garver *et al.* (a²⁵, b²⁶): BC strain of PRV can be transmitted to sockeye and chinook salmon, but does not cause HSMI or jaundice syndrome.

Haatveit et al.27: Molecular-level evidence related to PRV replication in red blood cells.

Godoy *et al.*²⁸: HSMI in Chilean farmed Atlantic salmon. Heart lesions with PRV-like virus found in Chilean farmed coho salmon.

Takano et al.²⁹: PRV-like virus causes blood disease, EIBS, in coho salmon.

Lund et al.30: PRV can help Atlantic salmon fight an SAV infection.

Polinski et al.³¹: Evidence of a limited early response to PRV infection in sockeye salmon, independent of co-infection with IHNV.

Wiik-Nielsen *et al.*³²: Evidence that PRV is higher when HSMI symptoms observed in farmed Atlantic salmon. Evidence also of complex co-infection dynamics.

Morton and Routledge³³: Review of aquaculture-related risk factors (including PRV) for wild Pacific salmon.

*Descriptions selectively highlight major features of key papers related to the health impairment potential of PRV. Colour coding: Blue – international research on PRV in North Atlantic, Chile, and Japan; Red – nongovernmental research pointing to potential risks posed by PRV to BC wild salmon; Green – governmental and industry research used to claim minimal risk to BC wild salmon.

2017 Di Cicco *et al.*³⁴: HSMI in BC. Strengthened connection between PRV and HSMI. Suggestion that DFO's Fish Health and Surveillance Program is not adequate to consistently diagnose HSMI.

Haatveit *et al.*³⁵: Initial acute PRV infection in red blood cells lasts only 1-2 weeks before subsiding. Wessel *et al.*³⁶: Confirmation that PRV can cause HSMI on its own.

Miller et al.³⁷: Correlational evidence that PRV may cause jaundice in farmed chinook salmon.

Purcell *et al.*³⁸: Evidence of PRV prevalence in coho and chinook salmon in Washington and SE Alaska.

Kibenge et al. 39: Critique of Siah et al. (2016).

Morton *et al.*⁴⁰: Correlational evidence linking both (i) salmon aquaculture to PRV dynamics in wild Pacific salmon, and (ii) PRV to weakened ability for Pacific salmon to return to higher-elevation spawning grounds.

Hauge *et al.*⁴¹: Further insight on the initial acute phase in the red blood cells of a PRV infection in Atlantic salmon.

2018 Madhun *et al.*⁴²: PRV prevalence in wild Atlantic salmon in northern Norway: ambivalent evidence on salmon farm exposure

Cartagena et al.43: Evidence of two strains of PRV in Chilean farmed rainbow trout mortalities.

Tucker *et al.*⁴⁴: Demonstration of value of molecular screening technique for detecting viral disease development. Low prevalence of PRV in juvenile Fraser River chinook not exposed to fish farms.

Di Cicco et al.45: PRV causes jaundice/anaemia in farmed chinook salmon in BC.

Wang⁴⁶

2019 Wessel *et al.*⁴⁷ Review of published findings on PRV infection, replication and effects on salmonid red blood cells.

Kibenge et al.48: 72 of 73 tissue samples from escaped farmed Atlantic salmon tested PRV-positive.

Polinski et al.⁴⁹: Laboratory trials pointing to lower PRV impact on Atlantic salmon in BC vs. Norway.

¹ Kongtorp, RT, Kjerstad, A, Taksdal T, Guttvik, A, and Falk, K. 2004a. Heart and skeletal muscle inflammation in Atlantic salmon, Salmo salar L.: a new infectious disease. J. Fish Dis. 27: 351-358.

² Kongtorp RT, Taksdal T, and Lyngøy A. 2004b. Pathology of heart and skeletal muscle inflammation (HSMI) in farmed Atlantic salmon Salmo salar. 2004b. Dis Aquat Org 59: 217–224.

³ Watanabe K, Karlsen M, Devold M, Isdal E, Litlabø A, and Nylund A. 2006. Virus-like particles associated with heart and skeletal muscle inflammation (HSMI) Dis Aquat Org 70: 183-192.

⁴ Kongtorp RT, and Taksdal T. 2009. Studies with experimental transmission of heart and skeletal muscle inflammation in Atlantic salmon, Salmo salar, L. J. Fish Dis 32: 253-262

⁵ Palacios G, Lovoll M, Tengs T, Hornig M, Hutchison S, Hui J, Kongtorp R, Savji N, Bussettii AV, Solovyov A, Kristoffersen AB, Celone C, Street C, Trifonov V, Hirschberg DL, Rabadan R, Egholm M, Rimstad E, and Lipkin WI. 2010. Heart and skeletal muscle inflammation of farmed salmon is associated with infection with a novel reovirus. PLoS ONE 5(7): e11487. doi:10.1371/journal.pone.0011487

⁶ Finstad ØW, Falk K, Løvoll M, Evensen Ø, and Rimstad E. 2012. "Immunohistochemical detection of piscine reovirus (PRV) in hearts of Atlantic salmon coincide with the course of heart and skeletal inflammation (HSMI)." Veterinary Research 43:27, 11 pp. DOI: 10.1186/1297-9716-42-27.

⁷ Løvoll M, Alarcón M, Jenson BB, Taksdal T, Kristoffersen AB, and Tengs T. 2012. Quantification of piscine reovirus (PRV) at different stages of Atlantic salmon Salmo salar production. Dis. Aquat. Org. 99: 7-12.

⁸ Kristoffersen AB, Bang Jensen B, Jansen PA. 2013. Risk mapping of heart and skeletal muscle inflammation in salmon farming. Prev Vet Med. 2013 Apr 1;109(1-2):136-43. doi: 10.1016/j.prevetmed.2012.08.012. Epub 2012 Sep 5. PubMed PMID: 22959429.

⁹ Garseth AH, Biering E, Aunsmo A. 2013a. Associations between piscine reovirus infection and life history traits in wild-caught Atlantic salmon Salmo salar L. in Norway. Prev Vet Med. 2013 Oct 1;112(1-2):138-46. doi: 10.1016/j.prevetmed.2013.06.007. Epub 2013 Jul 29. PubMed PMID: 23906390.

- ¹⁰ Garseth ÅH, Ekrem T, Biering E. 2013b. Phylogenetic evidence of long distance dispersal and transmission of piscine reovirus (PRV) between farmed and wild Atlantic salmon. PLoS One. 2013 Dec 11;8(12):e82202. doi: 10.1371/journal.pone.0082202. eCollection 2013. PubMed PMID: 24349221; PubMed Central PMCID: PMC3859594.
- ¹¹ Garseth ÅH, Fritsvold C, Opheim M, Skjerve E, and Biering E. 2013c. Piscine reovirus (PRV) in wild Atlantic salmon, Salmo salar L., and sea-trout, Salmo trutta L.in Norway. J Fish Dis.. 36: 483-493.
- ¹² Kibenge MJT, Iwamoto T, Wang Y, Morton A, Godov MG, and Kibenge FSB. 2013. Whole-genome analysis of piscine reovirus (PRV) shows PRV represents a new genus in family Reoviridae and its genome segment S1 sequences group into two separate sub-genotypes. Virol J 10:230-250.
- ¹³ Finstad OW, Dahle MK, Lindholm TH, Nyman IB, Løvoll M, Wallace C, Olsen CM, Storset AK, Rimstad E. Piscine orthoreovirus (PRV) infects Atlantic salmon erythrocytes. Vet Res. 2014 Apr 3;45:35. doi: 10.1186/1297-9716-45-35. PubMed PMID: 24694042; PubMed Central PMCID: PMC4234517.
- Miller KM, Teffer A, Tucker S, Li S, Schulze AD, Trudel M, Janes F, Tabata A, Kaukinen KH, Ginther NG, Ming TJ, Cooke SJ, Hipfner JM, Patterson DA, Hinch SG. 2014. Infectious disease, shifting climates, and opportunistic predators: cumulative factors potentially impacting wild salmon declines. Evol App. 2014 7:812-855.
- ¹⁵ Marty GD, Morrison DB, Bidulka J, Joseph T, Siah A (2014) "Piscine reovirus in wild and farmed salmonids in British Columbia, Canada" by. J Fish Dis 38: 159-164.
- Wessel Ø, Nyman IB, Markussen T, Dahle MK, Rimstad E. Piscine orthoreovirus (PRV) o3 protein binds dsRNA. Virus Res. 2015 Feb 16;198:22-9. doi:10.1016/j.virusres.2015.01.001. Epub 2015 Jan 14. PubMed PMID: 25596495.
- Wessel Ø, Olsen CM, Rimstad E, Dahle MK. Piscine orthoreovirus (PRV) replicates in Atlantic salmon (Salmo salar L.) erythrocytes ex vivo. Vet Res. 2015 Mar 6;46:26. doi: 10.1186/s13567-015-0154-7. PubMed PMID: 25888832; PubMed Central PMCID: PMC4350956.
- Olsen AB, Hjortaas M, Tengs T, Hellberg H, Johansen R. First Description of a New Disease in Rainbow Trout (Oncorhynchus mykiss (Walbaum)) Similar to Heart and Skeletal Muscle Inflammation (HSMI) and Detection of a Gene Sequence Related to Piscine Orthoreovirus (PRV). PLoS One. 2015 Jul 15;10(7):e0131638. doi: 10.1371/journal.pone.0131638. eCollection 2015. PubMed PMID: 26176955; PubMed Central PMCID: PMC4503464.
- Dahle MK, Wessel Ø, Timmerhaus G, Nyman IB, Jørgensen SM, Rimstad E, Krasnov A. Transcriptome analyses of Atlantic salmon (Salmo salar L.) erythrocytes infected with piscine orthoreovirus (PRV). Fish Shellfish Immunol. 2015 Aug;45(2):780-90. doi: 10.1016/j.fsi.2015.05.049. Epub 2015 Jun 6. PubMed PMID: 26057463.
- Bjørgen H, Wessel Ø, Fjelldal PG, Hansen T, Sveier H, Sæbø HR, Enger KB, Monsen E, Kvellestad A, Rimstad E, Koppang EO. Piscine orthoreovirus (PRV) in red and melanised foci in white muscle of Atlantic salmon (Salmo salar). Vet Res. 2015 Sep 8;46:89. doi: 10.1186/s13567-015-0244-6. PubMed PMID: 26346256; PubMed Central PMCID: PMC4562189.
- ²¹ DFO. 2015. Assessment of the Occurrence, Distribution and Potential Impacts of Piscine Reovirus on the West Coast of North America. DFO Can. Sci. Advis. Sec. Sci. Resp. 2015/037.
- ²² Siah A, Morrison DB, Fringuelli E, Savage P, Richmond Z, Johns R, et al. (2016) "Piscine Reovirus: Genomic and Molecular Phylogenetic Analysis from Farmed and Wild Salmonids Collected on the Canada/US Pacific Coast" PLoS ONE 11(10): e0164926.
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From:

Sent:

June-14-19 1:35 PM

To:

McCorquodale, Brenda

Cc:

rebecca.reid@dfo-mpo-gc.ca; Johansson, Todd; tim.timberg@justice.gc.ca;

Subject:

Fisheries and Oceans Canada ("DFO") Announcements of June 4, 2019

Attachments:

2019.06.14- 'Namgis First Nation (Chief Don Svanvik) letter dated June 13 2019 to Brenda

McCorquodale.pdf

Re: Fisheries and Oceans Canada ("DFO") Announcements of June 4, 2019

We attach 'Namgis First Nation's letter dated June 13, 2019 for your attention.

P: √

E:

F: +1 (604) 682-7131

WE ARE MOVING: As of July 15, 2019, our new address is: Suite 2600 – 1066 West Hastings Street, Vancouver, BC V6E 3X1

MLT Aikins LLP Suite 1800, 355 Burrard Street Vancouver, British Columbia V6C 2G8 mltaikins.com

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s.19(1)



June 13, 2019

BY EMAIL

Brenda McCorquodale Aquaculture Management Division Fisheries and Oceans Canada Suite 200 – 401 Burrard Street Vancouver, BC VON 1A0

Dear Ms. McCorquodale:

Re: Fisheries and Oceans Canada's ("DFO") announcements of June 4, 2019

We would like to thank Rebecca Reid, Regional Director General, for contacting me by text to inform me that she would be directing her staff to contact 'Namgis First Nation ("'Namgis") to arrange consultation on DFO's reconsideration of its policy not to test for the Piscine orthoreovirus ("PRV") when issuing licences under s. 56 of the Fishery (General) Regulations (the "PRV Policy")

To avoid confusion and to ensure an accurate record of consultation, we request that all communications with respect to consultation please go through

and Councillor Kelly Speck

(Kelly.Speck@namgis.bc.ca). When communicating in writing, either by letter or email, we also ask that you please copy our legal counsel,

Our legal counsel are keeping a record of consultation and functioning as a failsafe for correspondence in case recent problems we have had with our email server occur again.

June 4, 2019 Announcement

We would also like to address a number of issues related to DFO's June 4, 2019 announcement with respect to the PRV Policy.

As you know, on June 3, 2019, 'Namgis consented to a motion to vary the four-month suspension period for the judgment in Morton v. Canada (Fisheries and Oceans), 2019 FC 143.

As you are aware, 'Namgis' consent to that variance was predicated on a June 3, 2019 agreement between DFO and 'Namgis on how consultation will proceed over that four month period (the "Agreement").

s.19(1)

As you are also aware, 'Namgis opposed varying the suspension period by one-month because it was skeptical that DFO intended to, or could, consult in a meaningful way during that one-month period. 'Namgis was concerned DFO intended to use that one-month period to "paper" the record in an attempt to insulate its June 4 reconsideration of the PRV Policy from judicial review.

Despite agreeing in good faith to the four-month variance, 'Namgis is again disappointed that DFO has again proceeded in a way that confirms our skepticism about Crown's intention to consult in good faith.

On June 4, one day after 'Namgis and DFO had agreed how to consult on DFO's reconsideration of the PRV Policy, DFO effectively announced its reconsideration of the PRV Policy, without having had consulted 'Namgis on that reconsideration.

DFO announced its new PRV Policy as an "interim" approach. Calling it an interim approach does not change the fact that the Crown has made a decision without consulting with 'Namgis and is now acting on that decision. DFO did not announce a proposed policy that it may or may not implement depending on First Nation consultation and stakeholder feedback.

The PRV Policy is an ongoing course of conduct that has been reconsidered and re-affirmed at least six times. Each one of those reconsiderations could have been considered "interim" as they were all subject to future reconsiderations; yet each of those was a decision that attracted the duty to consult.

Had DFO intended to uphold the honour of the Crown, or the Agreement, it would have not proceeded with announcing its new PRV Policy on June 4. At the very least, DFO could have contacted 'Namgis to discuss the June 4 announcement prior to it being made. Disappointingly, but unsurprisingly, DFO has not discussed the June 4 announcement with 'Namgis before or since it was made.

We can only conclude that the Minister is more concerned about electioneering than maintaining the honour of the Crown and proceeded to announce DFO's new PRV Policy on June 4 for the media coverage it generated.

We can only conclude that the Minister has made a decision regarding the PRV Policy and now wishes to consult after the fact. We again remind DFO that it is required to consult early in its decision-making process, before that process it is too far advanced for 'Namgis' views to be meaningfully considered (Musqueam Indian Band v. British Columbia, 2005 BCCA 128 at para. 95; Dene Tha' First Nation v. Canada (Minister of Environment), 2006 FC 1354 at paras. 107-110). We further remind DFO that consultation cannot be the last point in a decision-making process in which the outcome has already been determined (Sambaa K'e Dene First Nation v. Duncan, 2012 FC 204, para. 165) and only provides 'Namgis with a token "opportunity to blow-off steam before the Minister proceeds to do what [he] intended to do all along" (Mikisew Cree First Nation v. Canada (Minister of Canadian Heritage), 2005 SCC 69, para. 54).

The content of the announcement also gives us considerable pause. It says "The government will seek public feedback on these two documents over a 60-day period, starting on June 4, which includes consultation with the Namgis (sic) First Nation to inform a final decision".

The Agreement does not require DFO to provide a full response to 'Namgis' March 29, 2019 letter until as late as August 8, 2019. It also does not require 'Namgis to provide proposed accommodations and rationales for those proposed accommodations until September 3, 2019. Those dates are both outside the 60-day period that DFO's announcement identified for feedback and consultation with 'Namgis. We hope that DFO is not intending to not live up to the Agreement by limiting consultation to 60 days.

We also remind DFO that announcements through the media do not constitute consultation and the public announcements cannot be construed as providing a First Nation with information for the purposes of consultation.

The Minister's Public Statements about 'Namgis

We are also extremely concerned that we have seen statements in the media, attributed to the Minister, that 'Namgis will participate in the Technical Working Groups that were announced on June 4, 2019.

The Minister does not speak on our behalf and has no right to do so. The statements attributed to the Minister may create the expectation in our membership that we will participate in those working groups. 'Namgis might be interested in participating in those working groups, but without discussions about our capacity for participation it is difficult for us to know if we can meet such an expectation. We ask the Minister to retract those statements about our participation, or if those statements were attributed to him in error, that he ask the media outlets reporting them to correct them.

Substance of the new PRV Policy

We are concerned that nothing in the materials that DFO provided to us prior to its unexpected June 4, 2019 announcement gave any indication of the substance of this new PRV Policy.

Nothing in the materials indicated that DFO would implement testing for heart and skeletal muscle inflammation ("HSMI") or Icelandic and Norwegian "strains" of PRV. This lack of information on the substance of the PRV Policy goes directly to an issue we have repeatedly raised: consultation cannot be meaningful if 'Namgis has not been informed and does not understand what the PRV Policy could be before it is considered by the decision maker.

Accordingly, we have specific questions related to DFO's announcement that it will test for HSMI and Icelandic and Norwegian "strains" of PRV:

- What steps will DFO take if fish test positive for HSMI and Icelandic and Norwegian "strains" of PRV?
- Who will test for HSMI, DFO or industry?
- When and how will this testing occur?
- What is the case definition that will be used to diagnose HSMI?
- Who will test for PRV?
- What methods will be used to test for PRV?

- How will the Icelandic and Norwegian "strains" of PRV be distinguished from other "strains" of PRV?
- What evidence does DFO have that there are any other "strains" of PRV other than Icelandic and Norwegian in British Columbia?
- How did DFO arrive at its conclusion that there is a "strain" of PRV native to British Columbia?
- Please provide use the full genomic sequence for all ten segments of the supposed native "strain" of PRV.

We look forward to your response.

Respectfully, Len Smught

Don Svanvik

'Namgis Chief Councillor

cc. Rebecca Reid, Regional Director General, Fisheries and Oceans Canada, Rebecca.Reid@dfo-mpo.gc.ca

Todd Johansson, Senior Aquaculture Management Coordinator, Todd.Johannson@dfompo.gc.ca

Brenda McCorquodale, Senior Aquaculture Management Coordinator, Brenda.McCorquodale@dfo-mpo.gc.ca

Tim Timberg, General Counsel, Department of Justice, Tim.Timberg@justice.gc.ca

First Nations Fisheries Council,

, Union of British Columbia Indian Chiefs,

British Columbia Assembly of First

Nations,

From:

Paylor, Adrienne

Sent:

June-14-19 4:24 PM

To:

Parsons, Jay; Burgetz, Ingrid; Lowe, Carmel; MacDougall, Lesley; Higgins, Mark; Medeiros,

Dear

Cc:

Webb, Allison; McConnachie, Sarah

Subject:

FW: Enhancements to FHAIP + Cost Options Paper

Attachments:

FHAIP Enhancements Estimated Cost.xls

Allison asked that I share the attached (very preliminary) sampling and testing cost estimates mentioned on this morning's call. These estimates do not include DNA sequencing (I believe Science is working on providing?). We are happy to follow up on any questions or required clarity.

Thank you, Adrienne

From: Paylor, Adrienne Sent: June-04-19 2:23 PM

To: Webb, Allison

Cc: Patirana, Anoma; McCorquodale, Brenda; Manchester, Howie; McConnachie, Sarah

Subject: FW: Enhancements to FHAIP + Cost Options Paper

Hi Allison,

Not sure if you still need this for today but you had asked for some costing on the enhanced DFO auditing proposal. Howie and Derek have put together a full accounting in the attached spreadsheet of the additional targeted marine sampling with full freshwater DFO audit (recommend by CEDS audit) or just the two year PRV survey costs (suggested in the Minister Note). Note that the full FW hatchery audit only costs an additional 40K for lab diagnostics if we are already traveling to the hatchery to collect samples for PRV. Options will differ depending on sample size for the % confidence and % prevalence levels we want to achieve. Howie only identified two additional BI-02's for the added field audits (one for marine and one for FW hatchery) however below I have added a full time Epi and half time data support in my summary table with minimum sample sizes. Totals can be adjusted depending on whatever FTE's you agree with......so 270.5K plus or minus FTE & sample size options in attached.

As we have discussed, the reality of running this enhanced FHAIP on going will require a full time Epi and Public Reporting/Data support team (Krista needs a permanent position as she is just on loan from benthic so could even ask for two BI-03's (Derek & Krista?). We also have to consider in the long term that we will have added vehicle and vessel demands that could impact our other programs (benthic and wild smolt seining) so may need a onetime Capital cost of about 130K: for an additional vehicle for hatchery audits (1 crew cab ¾ ton pick-up truck 55K) and an additional vessel (smaller boat for targeted marine sites 75K).

Item	Cost per Item	Total Cost per ye	
Staffing Salary Requirements: 2FTE field BI2 (75K X 2= 150K), 0.5FTE office data EG4 (37K), 1FTE epidemiologist (100K)	287		
Targeted marine sampling of mortality events: 15/year	53.75		
Targeted marine sampling of HSMI/Jaundice symptoms: 15/year	53.75		
Minister's FHAIP: FW hatchery PRV survey sampling Option 1 (95% confidence; other options in spreadsheet)	125.2		
Additional costs for full FW auditing program recommended by CEDS	37.8		
Minister's Enhanced FHAIP: Marine and Freshwater monitoring		51	

Let me know if you have any questions and we will keep working on this.

Thanks. Adrienne

From: Manchester, Howie Sent: June-03-19 4:05 PM To: Paylor, Adrienne

Cc: McConnachie, Sarah; Price, Derek

Subject: RE: Enhancements to FHAIP + Options Paper

Hi Adrienne.

Please see attached. Again the PRV sequencing cost is an unknown, I have put out some feelers but not sure if I can have anything by tomorrow. The estimate varies greatly depending on the design of the hatchery sampling, how many samples we need to take, how often and testing for what pathogens. I have put in different option.

I'm sure you will have more questions. I'm out on the water tomorrow but can try to answer tonight.

Howie

From: Paylor, Adrienne Sent: June-03-19 11:13 AM To: Manchester, Howie

Subject: FW: Enhancements to FHAIP + Options Paper

They are looking for some accurate cost to expand the audit program. Can you help me with this?

From: Webb, Allison Sent: June-03-19 10:58 AM

To: Paylor, Adrienne

Subject: FW: Enhancements to FHAIP + Options Paper

Hi – You might want to work on a ballpark.

I suggested 1-3 more FTEs for all of the work, O&M for travel + lab costs for about \$250K which might have been low. (is low)

If you can send something to me by Tues-Wed that would be fine. If I need it earlier, I'll let you know.

I'll send the latest version of the enhancements so you know what you're dealing with for the estimate,

Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture Fisheries Management Branch / Direction de la gestion des pêches Fisheries and Oceans Canada / Pêches et Océans Canada 200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada 604-666-7009 Allison.webb@dfo-mpo.gc.ca

From: Dostal, Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca>

Sent: Sunday, June 2, 2019 4:45 AM

To: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>; Thomson, Andrew < Andrew. Thomson@dfo-

mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>

Subject: RE: Enhancements to FHAIP + Options Paper

I raised resourcing with the DM on Friday morning (and had previously raised with Kevin).

I also flagged this to the DCFO on Friday as well.

I think it might be useful when people have a moment to figure out how much the resourcing ask would be that can't be absorbed in the region.

Alix Dostal

613-993-1884

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: Thursday, May 30, 2019 2:37 PM

To: Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca>; Reid, Rebecca < Rebecca. Reid@dfo-

mpo.gc.ca>; Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>

Subject: RE: Enhancements to FHAIP + Options Paper

I agree with Andy's points and have tried to flag this as well.

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>

Sent: Thursday, May 30, 2019 9:21 AM

To: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>; Reid, Rebecca < Rebecca. Reid@dfo-mpo.gc.ca>;

Dostal, Alexandra <<u>Alexandra.Dostal@dfo-mpo.gc.ca</u>> **Subject:** RE: Enhancements to FHAIP + Options Paper

I hate to be the wet blanket here and I'm certainly supportive of the screening enhancements that are being proposed, but we will need to consider how we will resource these enhancements and the TWGs.

Andrew J L Thomson

Regional Director | Directeur régional Fisheries Management Branch | Direction de la gestion des pêches Pacific Region | Région du Pacifique Fisheries & Oceans Canada | Pêches et Océans Canada

From: Webb, Allison

Sent: Thursday, May 30, 2019 8:11 AM

To: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-

mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; Dostal, Alexandra

<<u>Alexandra.Dostal@dfo-mpo.gc.ca</u>>; Campbell, John P. <<u>John.Campbell@dfo-mpo.gc.ca</u>>; McPherson,

Arran < Arran. McPherson@dfo-mpo.gc.ca>; House, Matthew (DOJ) < Matthew. House@justice.gc.ca>;

Levesque, Marie-Pier (DOJ) <marie-pier.levesque@justice.gc.ca>

Cc: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca >

Subject: RE: Enhancements to FHAIP + Options Paper

Hi Jay – I'm hoping that this addresses your comments, but please let me know if I missed anything or you wish to discuss further.

In terms of public facing info, it would be useful to say that we are increasing the DFO audit of the farms (more boots on the ground and more info to inform any future management changes as part of adaptive management and targeted audits are also consistent with the AusVet audit of our program that recommended this), but the increased reporting and testing would better to keep high level for consultation for a variety of reasons.

Thanks, Allison

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Sent: Thursday, May 30, 2019 4:53 AM

To: Webb, Allison < Allison.Webb@dfo-mpo.gc.ca >; Thomson, Andrew < Andrew.Thomson@dfo-

mpo.gc.ca>; Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; Dostal, Alexandra

< Alexandra. Dostal@dfo-mpo.gc.ca>; Campbell, John P. < John. Campbell@dfo-mpo.gc.ca>; McPherson,

Arran < Arran. McPherson@dfo-mpo.gc.ca>; House, Matthew (DOJ) < Matthew. House@justice.gc.ca>;

Levesque, Marie-Pier (DOJ) < marie-pier.levesque@justice.gc.ca>

Cc: Moore, Wayne < Wayne. Moore@dfo-mpo.gc.ca >

Subject: RE: Enhancements to FHAIP + Options Paper

Thank you Allison. This is looking good. I have just a few suggestions for clarification.

Jay

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca >

Sent: Wednesday, May 29, 2019 10:56 PM

To: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-

mpo.gc.ca>; Reid, Rebecca < Rebecca.Reid@dfo-mpo.gc.ca>; Dostal, Alexandra

<<u>Alexandra.Dostal@dfo-mpo.gc.ca</u>>; Campbell, John P. <<u>John.Campbell@dfo-mpo.gc.ca</u>>; McPherson,

Arran <Arran.McPherson@dfo-mpo.gc.ca>; House, Matthew (DOJ) <Matthew.House@justice.gc.ca>;

Levesque, Marie-Pier (DOJ) <marie-pier.levesque@justice.gc.ca>

Subject: Enhancements to FHAIP + Options Paper

Revisions to enhancements to FHAIP etc for consideration. Hopefully this document incorporates the changes from the discussion today as well as includes the helpful audits from and Science.

I've cross walked this to the Comms products, but of course, depending on approval of these elements, they should or should not be included. Of note – I did not include a ML on the survey work for PRV-1 in the hatcheries.

Feedback and edits always welcome, Allison

s.23

Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture Fisheries Management Branch / Direction de la gestion des pêches Fisheries and Oceans Canada / Pêches et Océans Canada

00 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada	
04-666-7009	
Allison.webb@dfo-mpo.gc.ca	

No information has been removed or severed from this page

Pages 751 to / à 752 are withheld pursuant to sections sont retenues en vertu des articles

21(1)(b), 21(1)(a)

of the Access to Information Act de la Loi sur l'accès à l'information

From:

MacDougall, Lesley June-19-19 11:09 AM

Sent: To:

Lowe, Carmel

Subject:

RE: Response outstanding: MINO: Key PRV Papers - Timeline for PRV Fish Health

Impairment Potential

From: Lowe. Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: June-19-19 11:05 AM

To: Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca>

Cc: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: Fwd: Response outstanding: MINO: Key PRV Papers - Timeline for PRV Fish Health Impairment

Potential

Do you know who this fellow is?

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Johal, Sharan" < Sharan.Johal@dfo-mpo.gc.ca>

Date: 2019-06-19 11:04 AM (GMT-08:00)

 $To: "Lowe, Carmel" < \underline{Carmel.Lowe@dfo-mpo.gc.ca} >, "Thomson, Andrew" < \underline{Andrew.Thomson@dfo-mpo.gc.ca} > \\$

Cc: "Barton, Meagan" < Meagan. Barton@dfo-mpo.gc.ca>, "Dickie, Catherine" < Catherine. Dickie@dfo-

mpo.gc.ca>, "La Chimea, Marisa" < Marisa.LaChimea@dfo-mpo.gc.ca>

Subject: RE: Response outstanding: MINO: Key PRV Papers - Timeline for PRV Fish Health Impairment Potential

MINO received the paper from

Sharan Johal

Tel: 604-666-1034 / Fax: 604-666-3295 NEW NUMBER

sharan.johal@dfo-mpo.gc.ca

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: Monday, June 17, 2019 3:39 PM

To: Johal, Sharan <Sharan.Johal@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-

mpo.gc.ca>

Cc: Barton, Meagan < Meagan.Barton@dfo-mpo.gc.ca>; Dickie, Catherine < Catherine.Dickie@dfo-

mpo.gc.ca>; La Chimea, Marisa < Marisa.La Chimea@dfo-mpo.gc.ca>

Subject: RE: Response outstanding: MINO: Key PRV Papers - Timeline for PRV Fish Health Impairment

Potential

Hi Sharan.

We have not seen before but looks like something that would have been producted by an ENGO or perhaps SFU.

s.19(1)

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7 Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360

Government of Canada | Gouvernement du Canada

From: Johal, Sharan < Sharan.Johal@dfo-mpo.gc.ca>

Sent: June 17, 2019 2:08 PM

To: Thomson, Andrew <<u>Andrew.Thomson@dfo-mpo.gc.ca</u>>; Lowe, Carmel <<u>Carmel.Lowe@dfo-mpo.gc.ca</u>>

Cc: Barton, Meagan < Meagan.Barton@dfo-mpo.gc.ca >; Dickie, Catherine < Catherine.Dickie@dfo-mpo.gc.ca >; La Chimea, Marisa < Marisa.LaChimea@dfo-mpo.gc.ca >

Subject: Response outstanding: MINO: Key PRV Papers - Timeline for PRV Fish Health Impairment Potential

Hi Andy and Carmel, when you have a moment can you please advise me if you've seen a copy of the attached before? MINO is inquiring and I'd like to respond to them.

Thanks! ☺

Sharan Johal

Tel: 604-666-1034 / Fax: 604-666-3295 NEW NUMBER

sharan.johal@dfo-mpo.gc.ca

From: Johal, Sharan

Sent: Tuesday, June 11, 2019 12:41 PM

To: Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca >; Webb, Allison < Allison. Webb@dfo-

mpo.gc.ca>; Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; McCorquodale, Brenda

<Brenda.McCorquodale@dfo-mpo.gc.ca>

Cc: Barton, Meagan < Meagan.Barton@dfo-mpo.gc.ca >; Dickie, Catherine < Catherine.Dickie@dfo-

mpo.gc.ca>; Delaney, Paula <Paula.Delaney@dfo-mpo.gc.ca>

Subject: MINO: Key PRV Papers - Timeline for PRV Fish Health Impairment Potential

Good afternoon all, have any of you received the attached before (the Minister has asked).

Thank you

Sharan Johal

A/Team Lead, Executive Secretariat

Regional Director General's Office/Bureau Directeur Général Regional

Fisheries and Oceans Canada - Pacific Region/ Pêches et Océans Canada - Région du Pacifique

200-401 Burrard Street / 401, rue Burrard, bureau 200

Vancouver, BC/CB V6C 3S4

Tel: 604-666-7102 / Fax: 604-666-8956

sharan.johal@dfo-mpo.gc.ca

From:

Medeiros, Dean

Sent:

June-19-19 11:16 AM

To:

Lowe, Carmel; Parsons, Jay; Burgetz, Ingrid; Webb, Allison; Paylor, Adrienne; McConnachie,

Sarah; MacDougall, Lesley; Higgins, Mark; Ang, Melanie

Subject:

FW: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1

Hello Everyone,

Please delete my previous e-mail. An additional document has been added to the list below (highlighted). Thanks Allison and Jay!

Cheers, Dean

From: Medeiros, Dean

Sent: Wednesday, June 19, 2019 1:59 PM

To: Lowe, Carmel.Lowe@dfo-mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Burgetz, Ingrid <Ingrid.Burgetz@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Paylor, Adrienne <Adrienne.Paylor@dfo-mpo.gc.ca>; McConnachie, Sarah <Sarah.McConnachie@dfo-mpo.gc.ca>; MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>; Higgins, Mark <Mark.Higgins@dfo-mpo.gc.ca>

Subject: RE: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1

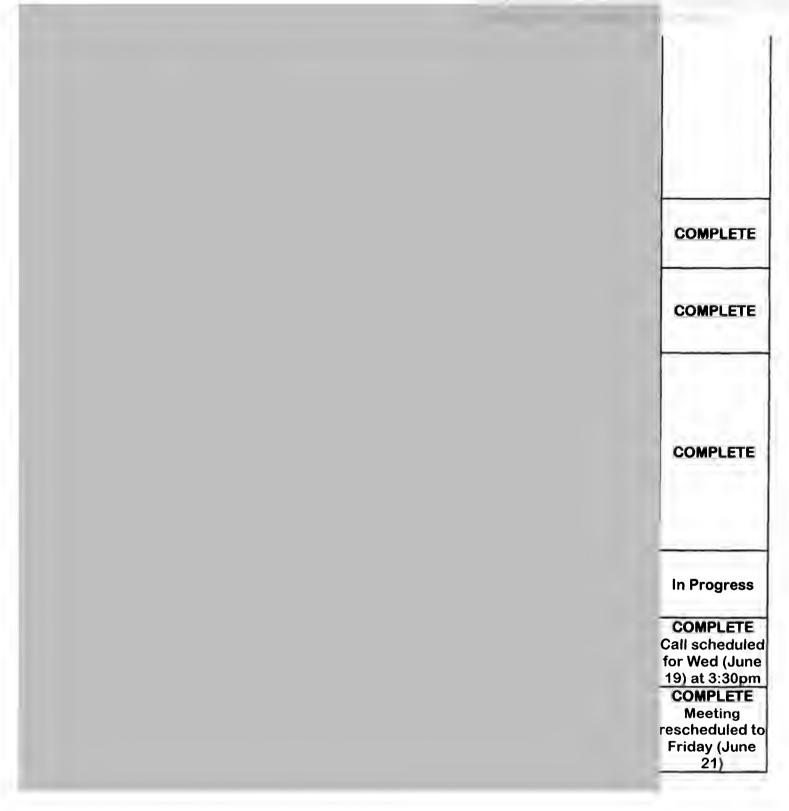
Hello Everyone,

Here's the updated action item list and associated documents/information.

Thanks all for your contributions and we look forward to the discussion later today.

Cheers, Dean

Actio	n	Lead(s)	Attachment(s)	Status
•	Share information on action items below by Monday or Tuesday (June 17/18).	All	N/A	•
				In progress
•	Provide a list of hatcheries: • Salmon hatcheries (12 Atlantic, 3 Chinook hatcheries) • Other fish for marine net-pen aquaculture (sablefish)?	DFO Pacific	Active Aquaculture Hat	COMPLETE



s.21(1)(a)

s.21(1)(b)

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: Wednesday, June 19, 2019 11:58 AM

To: Medeiros, Dean <<u>Dean.Medeiros@dfo-mpo.gc.ca</u>>; Parsons, Jay <<u>Jay.Parsons@dfo-mpo.gc.ca</u>>; Burgetz, Ingrid <<u>Ingrid.Burgetz@dfo-mpo.gc.ca</u>>; Webb, Allison <<u>Allison.Webb@dfo-mpo.gc.ca</u>>; Paylor, Adrienne <<u>Adrienne.Paylor@dfo-mpo.gc.ca</u>>; McConnachie, Sarah <<u>Sarah.Mcconnachie@dfo-mpo.gc.ca</u>>; MacDougall, Lesley <<u>Lesley.MacDougall@dfo-mpo.gc.ca</u>>; Higgins, Mark <<u>Mark.Higgins@dfo-mpo.gc.ca</u>>

Subject: RE: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1

Hi all.

Attaching our homework from last mtg. on options

(many thanks to

Mark for the heavy lifting on this). Welcome any feedback.

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

----Original Appointment----

From: MacDougall, Lesley On Behalf Of Medeiros, Dean

Sent: June 12, 2019 11:22 AM

To: Medeiros, Dean; Parsons, Jay; Burgetz, Ingrid; Webb, Allison; Paylor, Adrienne; McConnachie,

Sarah; MacDougall, Lesley; Higgins, Mark

Cc: Lowe, Carmel

Subject: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1

When: June 14, 2019 11:00 AM-12:00 PM (UTC-05:00) Eastern Time (US & Canada).

Where: 10N196

For those in Ottawa please join us in 10N196

Teleconference Details:

Dial in # - 1-877-413-4791 / 613-960-7515 Conference ID -

Cheers, Dean

--

Hello Everyone,

As part of the follow-up post the June 4th announcement (as discussed Monday at 2pm and addressed in the attached e-mail) we would like to discuss implementation aspects of the screening and testing.

In particular, we should strive to develop a better sense of timeframes/plans for implementation, for two scenarios:

s.16(2)(c)

Please confirm if the date and time works for the discussion.

s.21(1)(a) s.21(1)(b)

Room and teleconference details to follow.

Cheers, Dean

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Aquaculture Hatcheries in British Columbia

Finfish reared in freshwater, destined for marine netpens:

Atlantic salmon (Salmo salar) hatcheries:

- 1. Big Tree Creek (Mowi)
- 2. Boot Lagoon (Cermaq)
- 3. Dalrymple (Mowi)
- 4. Freshwater Farms (Mowi)
- 5. Gold River (Grieg)
- 6. Little Bear Bay (Cermaq)
- 7. Ocean Falls (Mowi)
- 8. Oceans (Cermaq)
- 9. Paradise Trading (Grieg)

Chinook salmon (Oncorhynchus tshawytscha) hatcheries:

- 1. Doctor Bay (Saltstream Engineering)
- 2. Sea Spring Hatchery (Creative)
- 3. Yellow Island Hatchery (Yellow Island Aquaculture)

Sablefish (Anoplopoma fimbria) hatcheries:

1. Sablefin

Snootli Creek Hatchery

Spus Creek Hatchery

Quinsam River Hatchery

Jenderfoot Creek Hatchery

Conuma River Hatchery

Puntledge River Hatchery

Big Qualicum Hatchery, Juttle Qualicum Hatchery Robertson Creek Hatchery

Capilano River Hatchery Chehais River Hatchery Inch Creek Hatchery

Chilimack River Hatchery

Nitinat Hatchery

Mamps Recirculating Project

Unique Sea Farms Gray Creek Lois Lake Hatchery, Jos Lake Site. Omega Pacific, Boot Lagoon Little Bear Bay Dalrymples Big Tree Creek Gold River

Sablefin

Sea Spring,

Freshwater Farms Ocean Farm

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21(1)(b), 21(1)(a)

of the Access to Information Act de la Loi sur l'accès à l'information

Pages 768 to / à 769
are duplicates of
sont des duplicatas des
pages 751 to / à 752

From: Lowe, Carmel

Sent:June-19-19 11:17 AMTo:Medeiros, DeanCc:MacDougall, Lesley

Subject: Declined: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1

(Part II)

I have a conflict with this mtg. Lesley will participate for Pacific Science.

Carmel

Sent from my Bell Samsung device over Canada's largest network.

From:

MacDougall, Lesley

Sent:

June-19-19 12:13 PM

To:

Webb, Allison; Lowe, Carmel

Cc:

Higgins, Mark; Miller-Saunders, Kristi; Garver, Kyle; Polinski, Mark; DiCicco, Emiliano; Jones,

Simon

Subject:

FW: Article: Tla-o-qui-aht board fish farms to obtain video footage of pens

Hi all - recent article for your info, and a heads up as this may be referred to at our meeting next week

Lesley

From: Geiger, Karen < Karen. Geiger @dfo-mpo.gc.ca>

Sent: June-19-19 12:08 PM

To: Nantel, Martin < Martin. Nantel@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley. MacDougall@dfo-

mpo.gc.ca>

Subject: FW: Article: Tla-o-qui-aht board fish farms to obtain video footage of pens

For info...

From: Geiger, Karen

Sent: June 19, 2019 12:05 PM

To: Malikian, Janine <<u>Janine.Malikian@dfo-mpo.gc.ca</u>>; Rainer, Michelle <<u>Michelle.Rainer@dfo-mpo.gc.ca</u>>; Girouard, Louise (<u>Louise.Girouard@dfo-mpo.gc.ca</u>) <<u>Louise.Girouard@dfo-mpo.gc.ca</u>>

Subject: Article: Tla-o-qui-aht board fish farms to obtain video footage of pens

Shared by an AADNC colleague. Article references PRV.

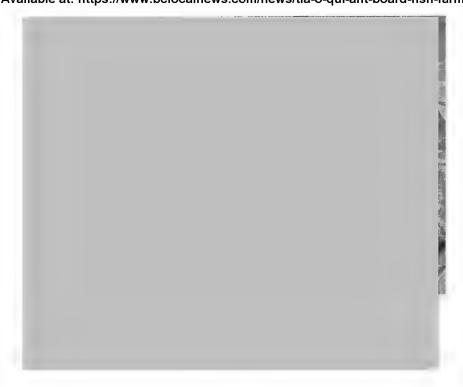
Hi Karen,

FYI – this was pulled in today's media summary

Tla-o-qui-aht board fish farms to obtain video footage of pens

On June 11, Tla-o-qui-aht First Nation members and Tribal Park allies boarded two Creative Salmon fish farms with Go Pros on rods to get video footage of what was inside the closed-net pens. The fish farms, both located in Tla-o-qui-aht unceded waters, were boarded under the authority of the Tla-o-qui-aht Hereditary Chief Ray Seitcher. (BC Local News, June 19, 2019) https://www.bclocalnews.com/news/tla-o-qui-aht-board-fish-farms-to-obtain-video-footage-of-pens/

Tla-o-qui-aht board fish farms to obtain video footage of pens - BC Local News / Document divulging en vertu Available at: https://www.bclocalnews.com/news/tla-o-qui-aht-board-fish-farms-to-obtain-video-footage-of-pens/



Tla-o-qui-aht board fish farms to obtain video footage of pens



s.68(a)

Pages 773 to / à 776 are withheld pursuant to section sont retenues en vertu de l'article

68(a)

of the Access to Information Act de la Loi sur l'accès à l'information

From:

Lowe. Carmel

Sent:

June-21-19 6:43 AM

To:

Moore, Wayne; Parsons, Jay; Dostal, Alexandra; Thomson, Andrew

Cc:

Medeiros, Dean: Burgetz, Ingrid: Ang., Melanie: Higgins, Mark: MacDougall, Lesley:

McConnachie, Sarah; Paylor, Adrienne; Webb, Allison

Subject:

Re: Implementation of Enhanced Measures: details on the PRV-1 survey

Me too.

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Moore, Wayne" < Wayne. Moore@dfo-mpo.gc.ca>

Date: 2019-06-21 6:34 AM (GMT-08:00)

To: "Parsons, Jay" <Jay.Parsons@dfo-mpo.gc.ca>, "Lowe, Carmel" <Carmel.Lowe@dfo-mpo.gc.ca>, "Dostal, Alexandra" <Alexandra.Dostal@dfo-mpo.gc.ca>, "Thomson, Andrew" <Andrew.Thomson@dfo-mpo.gc.ca> Cc: "Medeiros, Dean" <Dean.Medeiros@dfo-mpo.gc.ca>, "Burgetz, Ingrid" <Ingrid.Burgetz@dfo-mpo.gc.ca>, "Ang, Melanie" <Melanie.Ang@dfo-mpo.gc.ca>, "Higgins, Mark" <Mark.Higgins@dfo-mpo.gc.ca>, "MacDougall, Lesley" <Lesley.MacDougall@dfo-mpo.gc.ca>, "McConnachie, Sarah" <Sarah.Mcconnachie@dfo-mpo.gc.ca>, "Paylor, Adrienne" <Adrienne.Paylor@dfo-mpo.gc.ca>, "Webb, Allison" <Allison.Webb@dfo-mpo.gc.ca>

Subject: RE: Implementation of Enhanced Measures: details on the PRV-1 survey

I am good with this as a starting point for discuss today

From: Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Sent: June 20, 2019 5:48 PM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>; Dostal, Alexandra < Alexandra.Dostal@dfo-mpo.gc.ca>; Thomson, Andrew < Andrew.Thomson@dfo-mpo.gc.ca>; Moore, Wayne < Wayne.Moore@dfo-mpo.gc.ca>

Cc: Medeiros, Dean < Dean. Medeiros@dfo-mpo.gc.ca>; Burgetz, Ingrid < Ingrid. Burgetz@dfo-mpo.gc.ca>; Ang, Melanie < Melanie. Ang@dfo-mpo.gc.ca>; Higgins, Mark < Mark. Higgins@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca>; McConnachie, Sarah < Sarah. Mcconnachie@dfo-mpo.gc.ca>; Paylor, Adrienne < Adrienne. Paylor@dfo-mpo.gc.ca>; Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Subject: Implementation of Enhanced Measures: details on the PRV-1 survey

Alix. Carmel. Andv. Wavne:

AMD (Pac & NCR) and Science (Pac & NCR) have developed the attached discussion document on considerations, options and recommendations that further detail the proposed approach to undertaking the PRV survey of non-native strains in BC.

The document was developed to support the ADM-RDG discussion on tomorrow's call.

Document Released Under the Access to Information Act / Document divulgué en vertu

Could you please let us know if you are ok with this version being circulated to ADMs/RDG for ation	
tomorrow's call/meeting?	

Thank you,

Jay

<< File: PRV Survey of Hatchery Fish v3a.docx >>

No information has been removed or severed from this page

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Dickie, Catherine	
From: Sent: To: Subject:	McCorquodale, Brenda June-21-19 2:57 PM Morel, Philippe; Campbell, John P.; Reid, Rebecca; Lowe, Carmel; Webb, Allison; McPherson, Arran; Sharzer, Stephen (DOJ); Haesevoets, Roderick; Struthers, Alistair; Moore, Wayne; Thomson, Andrew; Girouard, Louise; Quinn, Caroline; Seguin, Natalie; Levesque, Marie-Pier (DOJ); Parsons, Jay; Dostal, Alexandra; Burgetz, Ingrid; Krahn, Danielle; Fagan, Ashley; Medeiros, Dean; Laframboise, Leslie (DOJ) RE: PRV Steering Committee Check In – Court Decision Extension
Attachments:	Materials requested; Fisheries and Oceans Canada ("DFO") Announcemtns of June 4, 2019
I was asked to circulate the most Please find them attached. Brenda	recent correspondence from the 'Namgis and to this group on our call today.
Brenda McCorquodale	
Regional Manager, Aquaculture R Direction des peches Pêches et O	esource Management Fisheries and Oceans Canada Gestionnaire régionale des ressources, céans Canada
1965 Island Diesel Way Nanaimo Telephone I Téléphone: 250-754	o, BC Nanaimo, CB V9S 5W8 Email Courriel: Brenda.McCorquodale@dfo-mpo.gc.ca -0367
(DOJ); Haesevoets, Roderick; Stru McCorquodale, Brenda; Seguin, N Danielle; Fagan, Ashley; Medeiros Subject: PRV Steering Committee	nn P.; Reid, Rebecca; Lowe, Carmel; Webb, Allison; McPherson, Arran; Sharzer, Stephen thers, Alistair; Moore, Wayne; Thomson, Andrew; Girouard, Louise; Quinn, Caroline; latalie; Levesque, Marie-Pier (DOJ); Parsons, Jay; Dostal, Alexandra; Burgetz, Ingrid; Krahn, John Dean; Laframboise, Leslie (DOJ) Check In – Court Decision Extension PM-3:00 PM (UTC-05:00) Eastern Time (US & Canada).
June 17th	
Please note new time on June 21s	;t
Thanks	
Sylvie	s.19(1)

Rescheduled to June 21st 12h30-13h30 (17.06.2019 – MMS)

1	ne	5th	
ш	ne	5th	

New series of meetings for PRV meetings

Teleconference Info

Dial-in: 1-877-413-4788

Passcode:

Merci

Sylvie

s.16(2)(c)

Webb. Allison From: Sent: June-21-19 6:55 PM

MacDougall, Lesley; Medeiros, Dean; Parsons, Jay; Burgetz, Ingrid; Paylor, Adrienne; To:

McConnachie, Sarah; Higgins, Mark; Lowe, Carmel; Ang, Melanie

RE: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1 (Part Subject:

II)

Sure not a problem from my perspective. I do think that we should try to keep our numbers down - not to exclude people, but just from a manageability and logistical perspective. We can bring people in for the various pieces for their expertise as required though. I would also suggest that we should include SEP. Tx for the suggestions Lesley.

Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture Fisheries Management Branch / Direction de la gestion des pêches Fisheries and Oceans Canada / Pêches et Océans Canada 200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada 604-666-7009 Allison.webb@dfo-mpo.gc.ca

From: MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca>

Sent: Wednesday, June 19, 2019 3:39 PM

To: Medeiros, Dean < Dean. Medeiros@dfo-mpo.gc.ca>; Parsons, Jay < Jay. Parsons@dfo-mpo.gc.ca>; Burgetz, Ingrid < Ingrid.Burgetz@dfo-mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; Paylor, Adrienne <Adrienne.Paylor@dfo-mpo.gc.ca>; McConnachie, Sarah <Sarah.Mcconnachie@dfompo.gc.ca>; Higgins, Mark <Mark.Higgins@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfompo.gc.ca>: Ang . Melanie <Melanie.Ang@dfo-mpo.gc.ca>

Subject: RE: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1 (Part II)

Hello all:

As we move to more detailed discussions about the PRV and testing protocol I recommend that Kristi and Stewart are included in the discussions to ensure that we're able to consider the options from all angles, and to help build a unified team around this issue.

Lesley

-----Original Appointment-----

From: Medeiros. Dean Sent: June-18-19 7:13 AM

To: Medeiros, Dean; Parsons, Jay; Burgetz, Ingrid; Webb, Allison; Paylor, Adrienne; McConnachie,

Sarah; MacDougall, Lesley; Higgins, Mark; Lowe, Carmel; Ang, Melanie

Subject: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1 (Part II)

When: June-19-19 3:30 PM-4:30 PM (UTC-05:00) Eastern Time (US & Canada).

Where: 10N194 / Teleconference: 1-877-413-4791 (6112696#)

s.16(2)(c)

Location: 10N194

Dial in # - 1-877-413-4791 / 613-960-7515

Conference ID -

Hello Colleagues - Below are the draft action items I noted from the call on Friday (June 14). Please advise me of any changes. Dean

Action	Lead(s)
 Share information on action items below by Monday or Tuesday (June 17/18). 	All
	DFO Pacific + AMD NHQ
Provide a list of hatcheries: Salmon hatcheries (12 Atlantic, 3 Chinook hatcheries) Other fish for marine net-pen aquaculture (sablefish)?	DFO Pacific
	DFO Pacific
	DFO Science
	DFO Science
	DFO Science • DFO Pacific
	AMD NHQ
	AMD NHQ

s.21(1)(b)

From:

Lowe, Carmel

Sent:

June-24-19 10:12 AM

To:

MacDougall, Lesley

Subject:

FW: Documents for ADM meeting

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

From: Genier, Sylvie < Sylvie. Genier@dfo-mpo.gc.ca>

Sent; June 21, 2019 12:17 PM

To: Reid, Rebecca <Rebecca.Reid@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; McPherson, Arran <Arran.McPherson@dfo-mpo.gc.ca>; Sharzer, Stephen (DOJ) <stephen.sharzer@justice.gc.ca>; Haesevoets, Roderick <Roderick.Haesevoets@dfo-mpo.gc.ca>; Struthers, Alistair <Alistair.Struthers@dfo-mpo.gc.ca>; Moore, Wayne <Wayne.Moore@dfo-mpo.gc.ca>; Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>; Girouard, Louise <Louise.Girouard@dfo-mpo.gc.ca>; Quinn, Caroline <Caroline.Quinn@dfo-mpo.gc.ca>; McCorquodale, Brenda <Brenda.McCorquodale@dfo-mpo.gc.ca>; Seguin, Natalie <Natalie.Seguin@dfo-mpo.gc.ca>; Levesque, Marie-Pier (DOJ) <marie-pier.levesque@justice.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>; Dostal, Alexandra <Alexandra.Dostal@dfo-mpo.gc.ca>; Burgetz, Ingrid <Ingrid.Burgetz@dfo-mpo.gc.ca>; Krahn, Danielle <Danielle.Krahn@dfo-mpo.gc.ca>; Fagan, Ashley <Ashley.Fagan@dfo-mpo.gc.ca>; Medeiros, Dean <Dean.Medeiros@dfo-mpo.gc.ca>; Laframboise, Leslie (DOJ) <Leslie.Laframboise@justice.gc.ca>; Sharzer, Stephen (DOJ) <stephen.sharzer@justice.gc.ca>; House, Matthew (DOJ) <Matthew.House@justice.gc.ca>; Campbell, John P. <John.Campbell@dfo-mpo.gc.ca> Subject: FW: Documents for ADM meeting

Good afternoon all.

I've been advised that participants have not received the documents for the meeting that was held at 2pm so here they are. At my end it shows that they were sent via the invitation so I'm very sorry about this.

Merci

Sylvie Genier

Executive Assistant / Adjointe exécutive

Assistant Deputy Minister's Office / Bureau du sous-ministre adjoint Aquatic Ecosystems Sector / Secteur des écosystèmes aquatiques 613-993-2734

From: Medeiros, Dean < Dean. Medeiros@dfo-mpo.gc.ca >

Sent: June-21-19 12:28 PM

To: Genier, Sylvie < Sylvie.Genier@dfo-mpo.gc.ca >

Cc: Dostal, Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca >; Campbell, John P. < John. Campbell@dfo-

mpo.gc.ca>; Webb, Allison < Allison.Webb@dfo-mpo.gc.ca>; McCorquodale, Brenda

<Brenda.McCorquodale@dfo-mpo.gc.ca>; Ang , Melanie < Melanie.Ang@dfo-mpo.gc.ca>; Krahn,

Danielle < Danielle.Krahn@dfo-mpo.gc.ca >

Subject: FW: Documents for ADM meeting

Hi Sylvie,

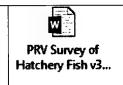
Attached are the DG-approved agenda and draft documents for the "PRV Steering Committee Check In" from 2-3pm today.

Thanks for your assistance!

Cheers, Dean

Agenda	Agenda - 21June2019 AD
Enhanced Sustainability of Aquaculture Engagement Schematic	Schematic of IMAB, TWGs, an
Table Description of Committees	Enhanced sustainability of
Draft letter for nominations	DFO call for nominations IM
Table of membership/ groups to contact/ potential appointees	IMAB TG membership op
Enhanced Sustainability Draft Budget	Enhanced Sustainability Dr

PRV Survey of Aquaculture Hatcheries – you've already seen (Jay sent yesterday)



From: Dostal, Alexandra < Alexandra. Dostal@dfo-mpo.gc.ca>

Sent: Friday, June 21, 2019 9:19 AM

To: Medeiros, Dean < Dean. Medeiros@dfo-mpo.gc.ca >

Cc: Campbell, John P. < <u>John.Campbell@dfo-mpo.gc.ca</u>>; Webb, Allison < <u>Allison.Webb@dfo-mpo.gc.ca</u>>; McCorquodale, Brenda < Brenda.McCorquodale@dfo-mpo.gc.ca>; Ang, Melanie

<Melanie.Ang@dfo-mpo.gc.ca>

Subject: Re: Documents for ADM meeting tomorrow

Pls feel free to send ahead!

Sent from my iPhone

On Jun 21, 2019, at 8:29 AM, Medeiros, Dean < <u>Dean.Medeiros@dfo-mpo.gc.ca</u>> wrote:

Hi Alix,

Here is the proposed agenda and documents for the ADM meeting today. Huge thanks to DFO Pacific for doing the heavy lifting!

If you approve, I will send to Sylvie (ADMO). Sorry for not getting this to you sooner.

Cheers, Dean

Agenda

Enhanced Sustainability of Aquaculture Engagement Schematic

Table Description of Committees

Draft letter for nominations

Table of membership/ groups to contact/ potential appointees

Enhanced Sustainability Draft Budget

PRV Survey of Aquaculture Hatcheries – you've already seen (Jay sent yesterday)

From: McCorquodale, Brenda < Brenda. McCorquodale@dfo-mpo.gc.ca >

Sent: Friday, June 21, 2019 1:17 AM

To: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca >; Medeiros, Dean < Dean. Medeiros@dfo-

mpo.gc.ca>

Subject: Documents for ADM meeting tomorrow

Hi Allison and Dean

Sorry for the email at this late hour, but Allison and I had a chat at the end of the day and so I am late providing updated materials.

Thank goodness for the time change!

Notes on the Agenda:

- Allison suggested that I update on the Tech Tables. We would like to include the attachments:
- -schematic (can you change the title to enhanced sustainability and not transformative aquaculture thx).
- table description of committees *Enhanced Sustainability of Aquaculture Engagement* document (updated attached).
 - Draft letter for nominations (DFO call for nominations IMAB WG)
- Table of membership/ groups to contact/ potential appointees (*IMAB TG membership options*)
 - Draft budget
- For the Namgis consultation section we should take out workplan and refer to:
 - Key upcoming dates
 - Correspondence
 - Consultation Plan

I think that was it. Thanks! Brenda

Brenda McCorquodale

Regional Manager, Aquaculture Resource Management Fisheries and Oceans Canada Gestionnaire régionale des ressources, Direction des peches Pêches et Océans Canada

1965 Island Diesel Way |Nanaimo, BC | Nanaimo, CB |V9S 5W8 Email | Courriel: Brenda.McCorquodale@dfo-mpo.gc.ca
Telephone I Téléphone: 250-754-0367

- <PRV Survey of Hatchery Fish v3a.docx>
- < Enhanced Sustainability Draft Budget.xls>
- <IMAB TG membership options.doc>
- <DFO call for nominations IMAB WG.doc>
- <Agenda 21June2019 ADM PRV Working Group meeting (v.4).docx>
- <Enhanced sustainability of Aquaculture Engagement (v.2).doc>
- <Schematic of IMAB, TWGs, and linkages to other committees (v.4).pdf>

Pages 796 to / à 820 are withheld pursuant to section sont retenues en vertu de l'article

23

of the Access to Information Act de la Loi sur l'accès à l'information

Subject: Implementation of Enhanced Measures for HSMI, Jaundice Syndrome, and PRV-1 (Part III)

Location: 10N194 / Teleconference: 1-877-413-4791

Start: Mon 24/06/2019 12:00 PM **End:** Mon 24/06/2019 1:00 PM

MO11 24/00/2019 1:00 FIVE

Recurrence: (none)

Meeting Status: Accepted

Organizer: Ang , Melanie

Required Attendees: Parsons, Jay; Burgetz, Ingrid; Webb, Allison; Paylor, Adrienne; McConnachie, Sarah;

MacDougall, Lesley; Higgins, Mark; Lowe, Carmel; Haesevoets, Roderick; Medeiros, Dean

Location: 10N194

Dial in # - 1-877-413-4791 / 613-960-7515

Conference ID -

Hello Everyone,

Setting aside some time today to debrief Friday's ADM meeting with the group. Apologies for this late notice.

Cheers, Melanie

From:

Webb. Allison

Sent:

June-24-19 3:05 PM

To:

McCorquodale, Brenda; Thomson, Andrew; Lowe, Carmel

Subject:

RE: Broughton LOU meeting on Wed

Hi Brenda – Nothing in particular at this time noting that we asked James Mack to sound out the group to see if they would be interested in having us provide the presentation that we provided to the AFN and FNFC ACC on the s. 56 and FARM. Industry had raised with us that the Broughton group would be interested in that.

Obviously we want to make them aware of the new announcements from a couple of weeks ago which we distributed so expect that they do know. They may have more detailed questions on those and Carmel may be able to respond or we can commit to following up with them to answer detailed questions.

We should keep alive the sea lice announcement that the Min is expected to make any day now. If it comes out tomorrow or Wed, you'll need to be ready to speak to that. I'll keep an eye out too.

Thanks so much, Allison

Allison Webb, Director / Directrice
Aquaculture Management / Gestion de l'aquaculture
Fisheries Management Branch / Direction de la gestion des pêches
Fisheries and Oceans Canada / Pêches et Océans Canada
200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada
604-666-7009
Allison.webb@dfo-mpo.gc.ca

From: McCorquodale, Brenda <Brenda.McCorquodale@dfo-mpo.gc.ca>

Sent: Monday, June 24, 2019 10:58 AM

To: Thomson, Andrew <Andrew.Thomson@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-

mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>

Subject: Broughton LOU meeting on Wed

Hi all

I'm not sure if you will be able to make it to the Broughton LOU meeting on Wednesday - I am planning to participate (I will be at PBS for the CRWG all day meeting but will step out in the morning while BC is presenting to find a quiet place to take the call).

Did anyone have any updates or issues you would like raised on the call? I see James Mack is on the agenda to update on DFO's PRV Policy, but I feel pretty up to speed on this so I should be able to provide a good overview.

Brenda

Brenda McCorquodale

Regional Manager, Enhanced Sustainability Initiative, Aquaculture Management Division Fisheries and Oceans Canada Gestionnaire régionale des ressources, Direction des peches Pêches et Océans Canada

1965 Island Diesel Way |Nanaimo, BC | Nanaimo, CB |V9S 5W8 Email | Courriel: Brenda.McCorquodale@dfo-mpo.gc.ca

Broughton LOU Finfish Aquaculture Recommendations Collaborative Implementation Forum (DFO, Industry, First Nations, BC)

Agenda

Wednesday, June 26, 2019 - 10:00 - 11:40 am

Online meeting – Telephone conference numbers: 1.877.353.9184 | ID

Co-Chairs: First Nations: (TBD) and BC: James Mack

Time	Agenda Item	Lead
10:00 – 10:15 am	Opening remarks • Agenda Review • Action item review from Meeting June 3rd Broughton Aquaculture ACTION	James Mack
10:15 – 10:30 am	IMIP Agreement - Updates (deadline end of July)	.
10:30 -10:45 am	Technical Working Group & Working Group Membership Update	Emily
10:45 – 11:15 am	Funding Updates • BC SRIF Update • Industry Funding • Collaborative Forum Support	James / MOWI / Cermaq
11:15 -11:30 am	FN Engagement Update	Charlie
11:15 11:30 am	 Update on related Aquaculture files Proposed changes to in Integrated Pest Management of Sea Lice (MOE) DFO PRV policy 	James Mack
11:30 – 11:40 am	Scheduling, Next Steps and Wrap	Chairs

s.16(2)(c) s.19(1)

Participants:

First Nations	Province	DFO	Industry Other
KHFN: TBC,	AGRI – James Mack,	Brenda	Cermaq:
	David Travia	McCorquodale	
Chief Rick	MIRR – Giovanni		
Johnson	Puggioni, Emily		MOWI:
MFN: Chief Richard	Thomas		
Sumner	FLNRORD – Charlie	Regrets:	
	Short, Denise Tucker		Regrets:

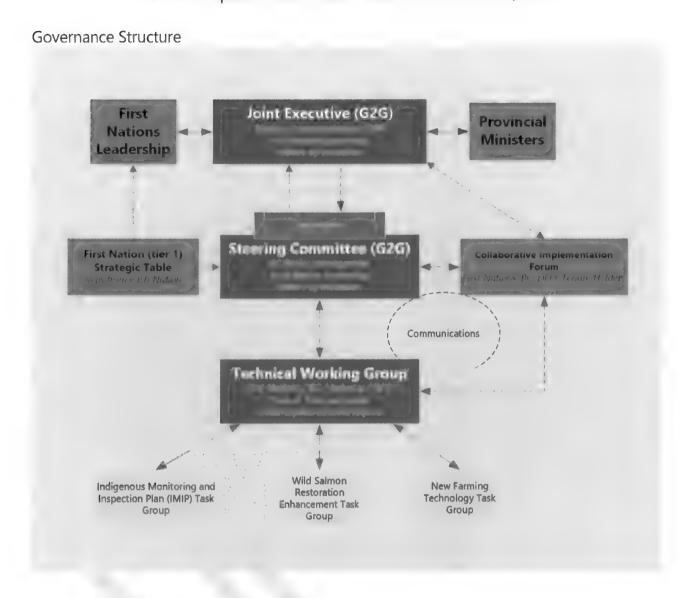
NFN:			
	Regrets:		

s.19(1)

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From the Implementation Plan - Final Draft - March 29, 2019



Broughton LOU Finfish Aquaculture Recommendations Implementation of Recommendations related to IMIP and Wild Salmon Restoration

Collaborative Implementation Forum ACTION ITEMS - DRAFT

Thursday June 3, 2019: 10:00 - 11:30 am

WHO	WHAT	BY WHEN	COMPLETE (Y/N)
	IMIP draft agreement to be shared with BC	?	
All	Identify members of Technical working Group – and forward to Heather	Mid June	
	Send out meeting invite for TWG meeting	End June	
All	Identify TWG agenda topics for discussion	Between now and June 7th	
	Craft initial TWG agenda	By TWG meeting start	
	Expressions of Interest to be shared with Industry		
DFO	Will follow up with available dates for meeting with First Nations and BC about Collaborative Research, monitoring objectives, use of lab		

Next meetings:

June 26, 2019 - 10:00 to 11:30 am - Telephone conference call.

June 12 or 13th: - **Technical Working Group – kick off meeting** – half day minimum – date, time and location all TBD. (Placeholder already sent out to Collaborative Implementation Forum group)

From:

Patirana, Anoma

Sent:

June-25-19 10:30 AM

To:

MacDougall, Lesley; Salomi, Corino; Parsons, Jay

Cc:

Payne, Brigid; Higgins, Mark; Keith, Ian; Lowe, Carmel

Subject:

RE: Exploring screening for PRV in SEP facilities

I don't participate in the meetings, but can certainly pass that message along to Allison to relay.

From: MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Sent: June-25-19 10:08 AM

To: Salomi, Corino < Corino. Salomi@dfo-mpo.gc.ca>; Patirana, Anoma < Anoma. Patirana@dfo-

mpo.gc.ca>; Parsons, Jay <Jay.Parsons@dfo-mpo.gc.ca>

Cc: Payne, Brigid <Brigid.Payne@dfo-mpo.gc.ca>; Higgins, Mark <Mark.Higgins@dfo-mpo.gc.ca>;

Keith, Ian <lan.Keith@dfo-mpo.gc.ca>; Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>

Subject: RE: Exploring screening for PRV in SEP facilities

Hi, there was no sooner time where we didn't lose over half of the needed participants.

Can we suggest to the ADMs that we would have a more informed response to provide if we are allowed to work on this next week and get it to them the week after?

Lesley

From: Salomi, Corino < Corino.Salomi@dfo-mpo.gc.ca>

Sent: Tuesday, June 25, 2019 9:48 AM

To: Patirana, Anoma < Anoma. Patirana@dfo-mpo.gc.ca >

Cc: Payne, Brigid < Brigid.Payne@dfo-mpo.gc.ca>; Higgins, Mark < Mark.Higgins@dfo-mpo.gc.ca>;

Keith, lan < lan.Keith@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: RE: Exploring screening for PRV in SEP facilities

Anoma,

See comments below in italics. Also Lesley has set a meeting for July 3 to discuss this. Allison is invited. I've attached the 2019 draft production plan and fish release table as a reference. One good thing is 99% of SEP releases don't start until April 2020.

Corino Salomi

Regional Manager, Enhancement Operations, Salmonid Enhancement Program Fisheries and Oceans Canada / Government of Canada Corino.Salomi@dfo-mpo.qc.ca / Tel: 604-666-8712

Gestionnaire Régionale, Programme de mise en valeur des salmonidés Pêches et Océans Canada / Gouvernement du Canada Corino.Salomi@dfo-mpo.qc.ca / Tél: 604-666-8712

From: Patirana, Anoma < Anoma. Patirana@dfo-mpo.gc.ca >

Sent: June-25-19 8:30 AM

To: Salomi, Corino < Corino.Salomi@dfo-mpo.gc.ca > Co: Payne, Brigid < Brigid.Payne@dfo-mpo.gc.ca >

Subject: RE: Exploring screening for PRV in SEP facilities

Hey Corino, to follow up on Allison's message yesterday we have received direction from ADMs that as a follow-up to the Minister's announcement on June 4th (which indicated that there would be testing for the two PRV foreign strains in industry hatcheries https://www.canada.ca/en/fisheries-

ustainability-in-british-columbia.html) that they wish to see similar testing applied to SEP hatcheries. When the announcement was made,				
		Based on this senior level direction, we have been asked		
to develop some options		In order to develop this we		
are wondering if you can provide us	with some information:			

oceans/news/2019/06/government-of-canada-takes-further-action-to-enhance-aquaculture-

I will follow up phone ASAP (just in meetings) but just wanted to share the above with you as a start. We need this information for next week but I've been asked to draft something sooner. Thank you in advance!

-Anoma

Anoma Patirana

A/Regional Manager, Aquaculture Policy Fisheries and Oceans Canada, Pacific Region anoma.patirana@dfo-mpo.gc.ca / Tel: 604-666-9571

Gestionnaire régionale intérimaire, Politique de l'aquaculture Pêches et Océans Canada, région du Pacifique anoma.patirana@dfo-mpo.gc.ca / Tél.: 604-666-9571

From: Salomi, Corino < Corino. Salomi@dfo-mpo.gc.ca>

Sent: June-24-19 4:34 PM

To: Patirana, Anoma < Anoma. Patirana@dfo-mpo.gc.ca >; Webb, Allison < Allison. Webb@dfo-mpo.gc.ca >;

Payne, Brigid < Brigid.Payne@dfo-mpo.gc.ca>

Cc: Paylor, Adrienne < Adrienne.Paylor@dfo-mpo.gc.ca > Subject: Re: Exploring screening for PRV in SEP facilities

OK

s.21(1)(a)

s.21(1)(b)

From: Patirana, Anoma

Sent: Monday, June 24, 2019 4:33 PM

To: Webb, Allison; Salomi, Corino; Payne, Brigid

Cc: Paylor, Adrienne

Subject: RE: Exploring screening for PRV in SEP facilities

Yes, I'll get in touch with you tomorrow Corino. Thanks in advance,

-Anoma

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: June-24-19 4:33 PM

To: Salomi, Corino <Corino, Salomi@dfo-mpo.gc.ca>; Payne, Brigid <Brigid.Payne@dfo-mpo.gc.ca> Cc: Patirana, Anoma < Anoma. Patirana@dfo-mpo.gc.ca>; Paylor, Adrienne < Adrienne. Paylor@dfo-

mpo.gc.ca>

Subject: RE: Exploring screening for PRV in SEP facilities

Anoma can go Sorry

through it with you Corino. Tx so much.

Allison

Allison Webb, Director / Directrice Aquaculture Management / Gestion de l'aquaculture

Fisheries Management Branch / Direction de la gestion des pêches

Fisheries and Oceans Canada / Pêches et Océans Canada

200 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada

604-666-7009

Allison.webb@dfo-mpo.gc.ca

From: Salomi, Corino < Corino. Salomi@dfo-mpo.gc.ca>

Sent: Monday, June 24, 2019 7:31 PM

To: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>; Payne, Brigid < Brigid. Payne@dfo-mpo.gc.ca> Cc: Patirana, Anoma < Anoma. Patirana@dfo-mpo.gc.ca>; Paylor, Adrienne < Adrienne. Paylor@dfo-

mpo.gc.ca>

Subject: Re: Exploring screening for PRV in SEP facilities

I am fine if we do some level of "screening or monitoring" or study

My feeling is science has already been doing some of this and could guide us in a measured approach. Resources for veterinary and sampling support would be good....

From: Webb, Allison

Sent: Monday, June 24, 2019 4:24 PM To: Salomi, Corino; Payne, Brigid Cc: Patirana, Anoma; Paylor, Adrienne

Subject: Exploring screening for PRV in SEP facilities

Hi you two - During our ADM call last week, the ADMs requested that we work with SEP to put together options 1

be following up with you to pick your brain about some ideas related to this and baseline info. We will also make sure that you are invited to future meetings.

Thanks so much,

Allison

s.21(1)(a)

Allison Webb, Director / Directrice

s.21(1)(b)

Aquaculture Management / Gestion de l'aquaculture

Fisheries Management Branch / Direction de la gestion des pêches

isheries and Oceans Canada / Pêches et Océans Canada	
00 - 401 Burrard St / Rue Burrard, Vancouver BC / C.B. V6C 3S4 Canada	
004-666-7009 Allison.webb@dfo-mpo.gc.ca	
No information has been removed or severed from this page	

From:

Webb, Allison

Sent:

June-26-19 10:48 AM

To:

Lowe, Carmel

Subject:

Re: PRV costing

Yes already am in touch with her. Thx so much.

Sent from my BlackBerry 10 smartphone on the Bell network.

From: Lowe, Carmel

Sent: Wednesday, June 26, 2019 1:27 PM

To: Webb, Allison; Webb, Cheryl; Thomson, Andrew **Cc:** To, Loretta; Payne, Brigid; MacDougall, Lesley

Subject: RE: PRV costing

Hi Allison,

Please connect with Lesley for the Science inputs?

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360

Government of Canada | Gouvernement du Canada

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: June 26, 2019 10:22 AM

To: Webb, Cheryl < Cheryl. Webb@dfo-mpo.gc.ca>; Thomson, Andrew < Andrew. Thomson@dfo-

mpo.gc.ca>

Cc: Lowe, Carmel <Carmel.Lowe@dfo-mpo.gc.ca>; To, Loretta <Loretta.To@dfo-mpo.gc.ca>; Payne,

Brigid < Brigid.Pavne@dfo-mpo.gc.ca>

Subject: Re: PRV costing

Corino has been working with us Cheryl. Thx

Sent from my BlackBerry 10 smartphone on the Bell network.

From: Webb, Cheryl

Sent: Wednesday, June 26, 2019 1:13 PM

To: Thomson, Andrew

Cc: Webb, Allison; Lowe, Carmel; To, Loretta; Payne, Brigid

Subject: Re: PRV costing

Andy, I am in Merritt today and will ask Brigid to let you know who from SEP will be working on this

Sent from my iPhone

On Jun 26, 2019, at 9:55 AM, Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca > wrote:

Need a defensible \$ value for PRV testing requirements this year so that we can seek funds from the carry over, and we may need today.

We can break it up by sector FM/SEP/Science or combine just so longs as were clear about the ask.

Andrew J L Thomson

Regional Director | Directeur régional
Fisheries Management Branch | Direction de la gestion des pêches
Pacific Region | Région du Pacifique
Fisheries & Oceans Canada | Pêches et Océans Canada
Suite 200 – 401 Burrard St.
Vancouver, BC, Canada V6C 3S4
andrew.thomson@dfo-mpo.gc.ca
Telephone | Téléphone 604.666.0751
Facsimile | Télécopieur 250.666.8069
Government of Canada | Gouvernement du Canada

No information has been removed or severed from this page

From:

McCorquodale, Brenda June-26-19 11:04 AM

Sent: To:

Lowe. Carmel

Subject:

RE: do you know what meeting is planned for Friday?

This IMIP they are talking about definitely includes some a lot of testing

Brenda

Brenda McCorquodale

Regional Manager, Enhanced Sustainability Initiative, Aquaculture Management Division Fisheries and Oceans Canada Gestionnaire régionale des ressources, Direction des peches Pêches et Océans Canada

1965 Island Diesel Way | Nanaimo, BC | Nanaimo, CB | V9S 5W8

Email | Courriel: Brenda.McCorquodale@dfo-mpo.gc.ca

Telephone I Téléphone: 250-754-0367

From: Lowe, Carmel

Sent: Wednesday, June 26, 2019 11:01 AM

To: McCorquodale, Brenda

Subject: RE: do you know what meeting is planned for Friday?

Thanks and yes interesting indeed. I wonder if they are also planning on establishing standards for PRV testing?!!

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

s.21(1)(a)

s.21(1)(b)

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

From: McCorquodale, Brenda < Brenda. McCorquodale@dfo-mpo.gc.ca>

Sent: June 26, 2019 10:45 AM

To: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Subject: RE: do you know what meeting is planned for Friday?

It's just a bilateral meeting between industry and FN to work on the IMIP agreement.

Interesting that they will be setting monitoring protocols and thresholds for sea lice. .. Brenda

Brenda McCorquodale

Regional Manager, Enhanced Sustainability Initiative, Aquaculture Management Division Fisheries and Oceans Canada Gestionnaire régionale des ressources, Direction des peches Pêches et Océans Canada

1965 Island Diesel Way | Nanaimo, BC | Nanaimo, CB | V9S 5W8 Email | Courriel: Brenda.McCorquodale@dfo-mpo.gc.ca
Telephone | Téléphone: 250-754-0367

From: Lowe, Carmel

Sent: Wednesday, June 26, 2019 10:44 AM

To: McCorquodale, Brenda

Subject: do you know what meeting is planned for Friday?

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177 Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

From:

To, Loretta

Sent:

June-26-19 3:06 PM

To:

Webb, Allison; Payne, Brigid; MacDougall, Lesley Thomson, Andrew; Webb, Cheryl; Lowe, Carmel

Cc: Subject:

Due June 27 14:00: PRV costing

Follow Up Flag:

FollowUp

Flag Status:

Flagged

Hello,

This is an update to advise that a response is required by **tomorrow**, **June 27 at 1400**. I will coordinate and further to Finance for inclusion into FM funding pressures.

Thank you.

Loretta To

Business Manager, Fisheries Management Branch Fisheries and Oceans Canada | Government of Canada Loretta.To@dfo-mpo.gc.ca | Telephone: (604) 666-3552

Gestionnaire des affaires, Direction de la gestion des pêches Pêches et Océans Canada | Gouvernement du Canada <u>Loretta.To@dfo-mpo.gc.ca</u> | Téléphone: (604) 666-3552

From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca>

Sent: Wednesday, June 26, 2019 10:27 AM

To: Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; Webb, Cheryl <Cheryl.Webb@dfo-mpo.gc.ca>;

Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca>

Cc: To, Loretta <Loretta.To@dfo-mpo.gc.ca>; Payne, Brigid <Brigid.Payne@dfo-mpo.gc.ca>;

MacDougall, Lesley <Lesley.MacDougall@dfo-mpo.gc.ca>

Subject: RE: PRV costing

Hi Allison,

Please connect with Lesley for the Science inputs?

Carmel

Carmel Lowe, Ph.D.

Regional Director Science | Directrice régionale des sciences Fisheries and Oceans Canada | Pêches et Océans Canada Pacific Biological Station | Station biologique du Pacifique 3190 Hammond Bay Rd, Nanaimo, BC, Canada V9T 6N7

Carmel.Lowe@dfo-mpo.gc.ca

Telephone | Téléphone 250-756-7177

Facsimile | Télécopieur 250-729-8360 Government of Canada | Gouvernement du Canada

From: Webb, Allison < Allison. Webb@dfo-mpo.gc.ca>

Sent: June 26, 2019 10:22 AM

To: Webb, Cheryl < Cheryl. Webb@dfo-mpo.gc.ca>; Thomson, Andrew < Andrew. Thomson@dfo-

mpo.gc.ca>

Cc: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca >; To, Loretta < Loretta.To@dfo-mpo.gc.ca >; Payne,

Brigid < Brigid.Payne@dfo-mpo.gc.ca >

Subject: Re: PRV costing

Corino has been working with us Cheryl. Thx

Sent from my BlackBerry 10 smartphone on the Bell network.

From: Webb, Cheryl

Sent: Wednesday, June 26, 2019 1:13 PM

To: Thomson, Andrew

Cc: Webb, Allison; Lowe, Carmel; To, Loretta; Payne, Brigid

Subject: Re: PRV costing

Andy, I am in Merritt today and will ask Brigid to let you know who from SEP will be working on this

Sent from my iPhone

On Jun 26, 2019, at 9:55 AM, Thomson, Andrew < Andrew. Thomson@dfo-mpo.gc.ca > wrote:

Need a defensible \$ value for PRV testing requirements this year so that we can seek funds from the carry over, and we may need today.

We can break it up by sector FM/SEP/Science or combine just so longs as were clear about the ask.

Andrew J L Thomson

Regional Director | Directeur régional

Fisheries Management Branch | Direction de la gestion des pêches Pacific Region | Région du Pacifique
Fisheries & Oceans Canada | Pêches et Océans Canada
Suite 200 – 401 Burrard St.
Vancouver, BC, Canada V6C 3S4

andrew.thomson@dfo-mpo.gc.ca

Telephone | Téléphone 604.666.0751

Facsimile | Télécopieur 250.666.8069

Government of Canada | Gouvernement du Canada

From: Miller-Saunders, Kristi
Sent: June-26-19 8:57 PM

To: MacDougall, Lesley; Webb, Allison
Cc: Higgins, Mark; Lowe, Carmel

Subject: RE: DFO Science - cost estimate for PRV screening and sequencing tests

Looks accurate to me, based on my input. Just an FYI, the upper limit of sequencing costs assumes a maximum of 200 positive fish. I suspect it will be lower than this, judging from the hatchery data I have seen to date.

Kristi

From: MacDougall, Lesley Sent: June 26, 2019 6:28 PM

To: Webb, Allison

Cc: Higgins, Mark; Miller-Saunders, Kristi; Lowe, Carmel

Subject: DFO Science - cost estimate for PRV screening and sequencing tests

Hi Allison;

Attached is a draft of the cost breakdown for both the Aquatic Animal Health and the Molecular Genetics Laboratories, based potential testing scenarios

As I amalgamated input from both Mark and Kristi I've asked them to give it one last look to ensure I didn't mess something up; if there are any corrections I'll get them to you tomorrow.

Also, I've attached an email (referred to in the costing document) regarding the patent that is used for the diagnostic testing.

If you have any questions please give me a call or shoot an email over, I'm in all day tomorrow

Lesley MacDougall

A/Division Manager, Aquatic Diagnostics, Genomics & Technology / Division des diagnostics, la génomique, de la technologie aquatique Fisheries and Oceans Canada / Péches et Océans Canada Pacific Biological Station / Station Biologique du Pacifique Nanaimo, B.C. V9T 6N7 2,50-7,30,5

Lesley.MacDougall@dfo-mpo.gc.ca

Lesley

s.19(1) s.21(1)(a) s.21(1)(b)

s.23

Higgins, Mark From: June-27-19 9:12 AM Sent: Choi, Shirley, Lowe, Carmel, Webb, Allison, MacDougall, Lesley To: Miller-Saunders, Kristi Cc: Re: DFO Science - cost estimate for PRV screening and sequencing tests Subject: Thank you Shirley. Mark. Sent from my Bell Samsung device over Canada's largest network. ----- Original message -----From: "Choi, Shirley" <Shirley.Choi@dfo-mpo.gc.ca> Date: 2019-06-27 9:03 AM (GMT-08:00) To: "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca>, "Higgins, Mark" < Mark.Higgins@dfo-mpo.gc.ca>, "Webb, Allison" < Allison. Webb@dfo-mpo.gc.ca>, "MacDougall, Lesley" < Lesley. MacDougall@dfo-mpo.gc.ca> Cc: "Miller-Saunders, Kristi" < Kristi. Saunders@dfo-mpo.gc.ca> Subject: RE: DFO Science - cost estimate for PRV screening and sequencing tests No problem! On my spreadsheet, I am differentiating costs as either O&M and S&W. I will note somewhere that if only O&M is provided, they will need to increase it by the conversion rate. Shirley From: Lowe, Carmel < Carmel.Lowe@dfo-mpo.gc.ca> Sent: Thursday, June 27, 2019 8:41 AM To: Higgins, Mark <Mark.Higgins@dfo-mpo.gc.ca>; Webb, Allison <Allison.Webb@dfo-mpo.gc.ca>; MacDougall, Lesley < Lesley. MacDougall@dfo-mpo.gc.ca> Cc: Miller-Saunders, Kristi < Kristi. Saunders@dfo-mpo.gc.ca>; Choi, Shirley < Shirley. Choi@dfompo.gc.ca> Subject: Re: DFO Science - cost estimate for PRV screening and sequencing tests Good point Mark - definitely should include these costs. Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Higgins, Mark" < Mark. Higgins@dfo-mpo.gc.ca>

Date: 2019-06-27 7:49 AM (GMT-08:00)

To: "Webb, Allison" < Allison. Webb@dfo-mpo.gc.ca>, "MacDougall, Lesley" < Lesley. MacDougall@dfo-

mpo.gc.ca>

Cc: "Miller-Saunders, Kristi" < Kristi.Saunders@dfo-mpo.gc.ca>, "Lowe, Carmel" < Carmel.Lowe@dfo-

mpo.gc.ca>, "Choi, Shirley" < Shirley.Choi@dfo-mpo.gc.ca>

Subject: Re: DFO Science - cost estimate for PRV screening and sequencing tests

Looks good to me Lesley, one point that I noticed is that we have put in for salary \$\$, but if we get a lump sum transfer, o&m will have to be converted at x1.27. Not sure if this should be reflected in our ask or not Mark.

Sent from my Bell Samsung device over Canada's largest network.

----- Original message -----

From: "Webb, Allison" < Allison. Webb@dfo-mpo.gc.ca>

Date: 2019-06-26 6:33 PM (GMT-08:00)

To: "MacDougall, Lesley" < Lesley. MacDougall@dfo-mpo.gc.ca>

Cc: "Higgins, Mark" < Mark. Higgins@dfo-mpo.gc.ca>, "Miller-Saunders, Kristi" < Kristi. Saunders@dfo-

mpo.gc.ca>, "Lowe, Carmel" < Carmel.Lowe@dfo-mpo.gc.ca>, "Choi, Shirley" < Shirley.Choi@dfo-mpo.gc.ca>

Subject: RE: DFO Science - cost estimate for PRV screening and sequencing tests

Thanks so much for this Lesley, I just finished talking to Shirley Choi who is going to put all of this together for us. I just reviewed the framework of the excel tables with her. She will pop this into it and if she has any questions, she'll give you a call tomorrow.

This is due at 2pm so there might even be a chance that Shirley can finish this in the am and send around to everyone for a quick check before sending it to Andy in the afternoon.

I really appreciate everyone's help. I'll be in transit more of tomorrow, but will check first thing in the am and when I transfer flights.

Thanks again,

Allison

s.19(1)

From: MacDougall, Lesley Sent: June 26, 2019 6:28 PM s.21(1)(a)

s.21(1)(b)

To: Webb, Allison

Cc: Higgins, Mark; Miller-Saunders, Kristi; Lowe, Carmel

Subject: DFO Science - cost estimate for PRV screening and sequencing tests

s.23

Hi Allison:

Attached is a draft of the cost breakdown for both the Aquatic Animal Health and the Molecular Genetics Laboratories, based potential testing scenarios

As I amalgamated input from both Mark and Kristi I've asked them to give it one last look to ensure I didn't mess something up; if there are any corrections I'll get them to you tomorrow. Also, I've attached an email (referred to in the costing document) regarding the patent that is used for the diagnostic testing.

If you have any questions please give me a call or shoot an email over, I'm in all day tomorrow

Lesley MacDougall

A/Division Manager, Aquatic Diagnostics, Genomics & Technology / Division des diagnostics, la génomique, de la technologie aquatique Fisheries and Oceans Canada / Péches et Océans Canada Pacific Biological Station / Station Biologique du Pacifique

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250-756-7395	
Lesley.MacDougall@dfo-mpo.gc.ca	
Lesley	
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Pages 841 to / à 844 are withheld pursuant to sections sont retenues en vertu des articles

21(1)(b), 21(1)(a)

of the Access to Information Act de la Loi sur l'accès à l'information

From:

MacDougall, Lesley

Sent:

June-27-19 9:16 AM

To:

Lowe, Carmel

Subject:

just confirming I will be on the PRV steering committee call today

Hope the Franklin event goes smoothly...

Lesley MacDougall

A/Division Manager, Aquatic Diagnostics, Genomics & Technology / Division des diagnostics, la génomique, de la technologie aquatique Fisheries and Oceans Canada / Péches et Océans Canada Pacific Biological Station / Station Biologique du Pacifique Nanaimo, B.C. V9T 6N7

250-756-7395

Lesley.MacDougall@dfo-mpo.gc.ca

From: Simard, Marie-Michelle Sent: June-27-19 9:47 AM

To: Reid, Rebecca; Burgetz, Ingrid; Quinn, Caroline; Struthers, Alistair; Laframboise, Leslie (DOJ);

Seguin, Natalie; Levesque, Marie-Pier (DOJ); Sharzer, Stephen (DOJ); Girouard, Louise; Thomson, Andrew; McPherson, Arran; Krahn, Danielle; Campbell, John P.; Webb, Allison; Lowe, Carmel; McCorquodale, Brenda; Medeiros, Dean; Haesevoets, Roderick; Parsons, Jay; Dostal, Alexandra; Moore, Wayne; Fagan, Ashley; MacDougall, Lesley; Ang, Melanie; Green,

Barry

Subject: DOCUMENTS: PRV Steering Comm. Meeting (2pm)

Bonjour,

Please find attached the documents for this afternoon's PRV Steering Committee Check-In.

If you have any questions, please do not hesitate to contact me.

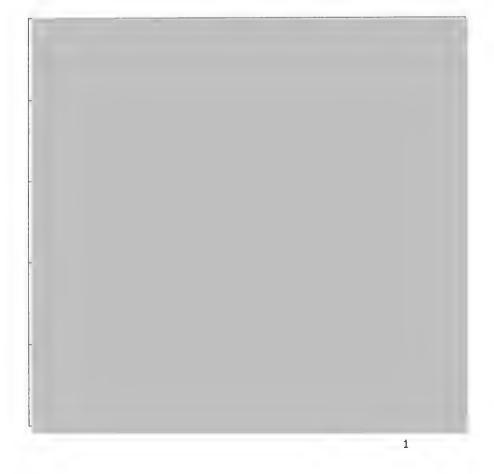
Merci,

Marie-Michelle Simard

Assistant Deputy Minister's Office | Bureau du sous-ministre adjoint Aquatic Ecosystems | Secteur des écosystèmes aquatiques Fisheries and Oceans Canada/Pêches et océans Canada

Tel: 613-990-7110

Marie-Michelle.Simard@dfo-mpo.gc.ca



s.21(1)(a) s.21(1)(b) s.23



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s.21(1)(a) s.21(1)(b)

s.23

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page 797

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Dickie, Catherine

From:

Webb. Allison

Sent:

June-27-19 2:25 PM

To:

Thomson, Andrew; To, Loretta

Cc:

Choi, Shirley; Higgins, Mark; Miller-Saunders, Kristi; Parsons, Jay; MacDougall, Lesley;

Salomi, Corino: Patirana, Anoma; McCorquodale, Brenda; Paylor, Adrienne; Lowe, Carmel;

Dostal, Alexandra

Subject:

FW: Cost Estimate

Attachments:

Implementation of June 4 2019 Aquaculture Annoucement xlsx

Hi Andy and Loretta - Please find our preliminary estimate for the full costs to all sectors to implement all of the aspects of the Minister's announcement on June 4th (PRV 1 testing, HSMI/jaundice increased monitoring, reporting and testing and the Technical Working Groups).

Please note that this does include costs for as directed by the ADM Committee. We have had to make quite a few assumptions with these estimates due to the short timeline to turn this around. We will continue to refine this over the next few weeks. This should represent a worse case (highest cost) scenario, but given high uncertainty in some areas, some costs may be under estimated.

Please let us know if you require additional information and we'll continue to work on this in parallel. We will need to get answers fairly soon re proceeding with staffing.

My thanks to everyone for their help on this under tight deadlines and especially to Shirley for doing the heavy lifting on this, Allison

s.21(1)(a)

s.21(1)(b)

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21(1)(b), 21(1)(a)

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